Introduction

Micro-Master® controllers are designed and manufactured in Australia to manage irrigation scheduling with the highest priority being water conservation.
Listed below are some important features you should be aware of before programming.
Details on how to implement these features are described in the following pages.

- 8 irrigation programs with or without Chemical Injection.
- Optional setup as a sequential or group operation controller.
- Separate fertilizer injections for each Program. Fertiliser 1 and 2 with separate meters.
- Four station filter program interactive with Chemical injection and main irrigation.
- Program runtimes and Chemical can be setup in seconds, minutes or Volumetric.
- Water budgeting for each program.
- Rain Switch to disable all programs.
- Semi-Automatic operation.
- Individual Valve Manual operation
- External field inputs for various Program Starts, Stops, and suspend facilities.
- Skip and report on Current over-load & pressure/flow error using Auto-skip input.
- 25 groups of up to 8 valves in each group. Maximum load = 2 Amps AC.
- Sequencing of valves switching on to reduce Inrush currents and wire size.
- Load distant valves into a group first to be switched on first when copper losses are minimum.
- If filter and/or Chemical injection valves are not used, (stations 26 to 32) the stations can be used for irrigation by including them within group programs.
- Programmable pump off delay for slow turn off valves (0-99 seconds).
- Ignore hold input at the start of irrigation for a user programmable time (0-99 seconds).
- Irrigation and Chemical injection totalisers to continuously total the irrigation and Chemical injection time for each station or group for seasonal reporting.
- Time-Zone irrigation (programmable for each Day) to allow full use of off-peak power supply, or in areas where water is allocated at a set time.
- Multiple starts. Programs 1 to 8 can have up to 9 starts each. Automatic sorting of Start Times in Chronological order. Display the next program to start with Day and Start time**.**
- Cyclic irrigation. Each program can have up to 99 repeats.
- Solar power option. Generate 24 VAC to operate standard solenoid valves from a 12VDC supply to prevent cable damage due to electrolysis caused by DC current.
- Proportional Chemical Injection. Enables constant concentration of chemical injection independent of flow rate.
- Log Communication, irrigation, or Chemical injection faults and set external alarm or trigger auto-dialer to send SMS message.
- Rainfall Cancel. Cyclic Log of rainfall (1-7 days) using a Rain Bucket and will Disable Irrigation when rainfall exceeds a user defined threshold. When rainfall in the log is cycled out, it will re-enable other controllers in the system.
- Radio-Master Spread spectrum radio control valves. Not an add on, but fully integrated into controller operation and reporting on valve operation, signal strength, battery , Temp etc
- **When used with central Software**.
- Communication protocols are **RS232** (RS232 or UHF Radio or Telephone or GSM). **AND**
- **RS485** (RS485 or Radio-master) . ***RS232 & RS485 can operate concurrently.***
- Flow Control. Set Flow variants to report a fault, or skip and report and cancel Irrigation.
- Send SMS messages when Communication, irrigation, or Chemical injection faults occur in the field.

Contents

Page

CHAPTER 1 Concepts of the Micro-Master® 4500 Plus 1

CHAPTER 2 Familiarization with the controller 6

CHAPTER 3 Controller Programming 8

3.1 Setting Time and Day 8
3.2 Required Data for an Irrigation Program 8
3.2.1. Day Table 9
3.2.2. Start Times 9
3.2.3. Run Times 10
3.2.3a. Accumulative Run Times 11
3.2.4. Water Budget 12
3.2.5. Irrigation Cycles 12
3.2.6. Filter Program 13
3.2.6.1. Initial P.D Delay 13
3.2.6.2. Filter Cycle Delay 14
3.2.6.3. P.D. Switch Backup Delay 14
3.2.6.4. Filter Inter-Station Delay 14
3.2.7. Chemical Injection 15
3.2.7.1. First Injection 15
3.2.7.2. Second Injection 15
3.2.7.3. Pre-wetting / Mixing Time 15
3.2.7.4. Delay between First and Secondary Injection 15
3.2.8 Rain Switch – Stand alone operation 17
3.2.9 Rain Switch and Rain Bucket 17
3.3 Sensors 18
3.3.1 Rain Bucket 18
3.3.2 Setting The Auto-Skip Delay Times 19
3.3.3 Flow Pulse Meter Setup 20
3.4 Entering Radio-Master Data 21

CHAPTER 4 Controller Operation 23

4.1 Semi-Automatic Operation 23
4.2 Manual Operation 23
4.3 Manual Operation with Radio-Master 24
4.4 Screens During Irrigation 25
4.4.1. Sequential Mode 25
4.4.2. Group Irrigation Mode 26

CHAPTER 5 Controller Set Up Functions 27

5.1. Clear All Programs 27
5.2 Self-Test Diagnostic Procedures 28
5.2.1 Serial Port Test 28
5.2.2 Controller Test 28
5.2.2.1 Program Memory Check 28
5.2.2.2 Key Pad Check 28
5.2.2.3 Output Relay Check 29
5.2.2 4 Input Check 29
5.3 Setting Program Time Base 30
5.4 Program Delays. 30
5.4.1 Pump Off Delay. 30
5.4.2 Delay Before Hold 31
5.4.3 Inter-station Delay 31
5.4.4 Delay between each valve switching On within a group 31

5.5 Multiple functions of the Alarm output 32
5.5.1 Inverter control. 32
5.5.2. Alarm Output Function. 32
5.5.3 Master / Slave Function. 32
5.6 Group or Sequential Irrigation 33
5.7 Inhibit or Enable Chemical Injection During Filtration 33
5.8 Proportional Chemical Injection 33
5.9 Communications Protocol 33
5.9.1 Telephone Communications 34
5.9.2 GSM Communications 34
5.9.3 Entering Radio-Master Data into Micro-Master. 34
5.9.4 RS232 Communications 34
5.9.4-1 RS232 Communications – VHF Radio 34
5.9.5 RS485 Communications 35
5.10 Enter Phone Numbers. And Controller ID-Code. 35

CHAPTER 6 Reports 36

6.1 Irrigation Totaliser Report 36
6.2 Faulty Station Report 37
6.2.1 Auto-dialler. 37
6.3 Read / Reset Flow Meters 38

CHAPTER 7 Auxiliary Functions 39

7.1 Time-Zone 39
7.2 Pause Irrigation from the keyboard 40
7.3 External Connections and Functions 40
7.3.1 GND. 40
7.3.2 BLACK 40
7.3.2 RED 40
7.3.3 P.D to GND 40
7.3.4 RESET To GND 41
7.3.5 ASTRT To GND 41
7.3.6 BSTRT To GND 41
7.3.7 A.SKIP To GND 41
7.3.8 Hold To Gnd 42
7.3.9 Alarm Output 42
7.3.10 FLOW1 to GND 42
7.3.11 FLOW2 to GND 43
7.3.12 FLOW3 to GND 43
7.3.13 RAIN to GND 43
7.4 Output Connections 44
7.5 Master Slave Operation using a spare station 45
7.5.1 Master/Slave operation using ALARM terminal. 46
7.6 Inverter Control / Solar Operation 47
7,6.1 Program Setup 49
7.7 Connecting 2 or more Pump Starts Together 49

Appendix 1 Installation Instructions 50

Appendix 2 Technical Specifications 53

Appendix 3 Fault Finding 55

Appendix 4 Glossary Or Terms 59

CHAPTER 1 Concepts of the Micro-Master® 4500 Plus

Introduction

For the sake of brevity, description and program examples will be for Program 5 only. However, the operation of all programs is identical in every respect to program 5.

Description of the Micro-Master® **4500 Plus Series controller.**

The Micro-Master® 4500 Plus series controller features are as follows.

The Controller can be set up in two different modes
1 *Sequential Irrigation*
2. *Group Irrigation.*

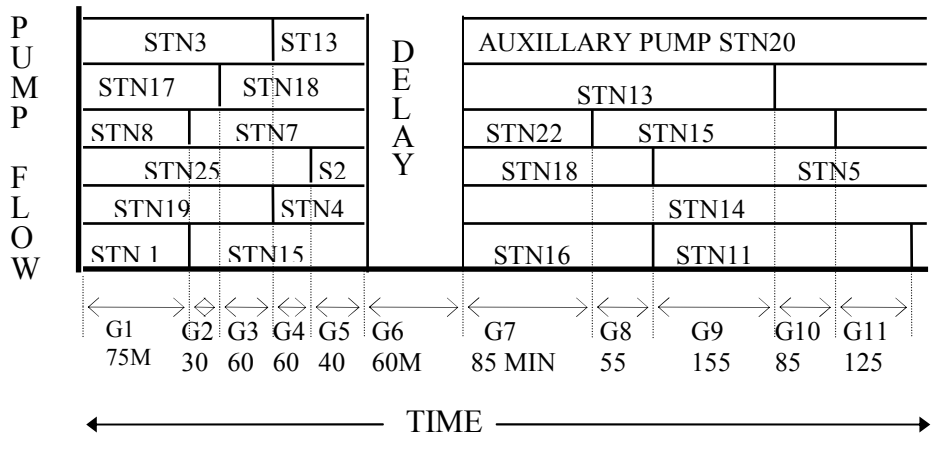
1. What is a Sequential Irrigation Program.

Allocate a runtime to each individual station output. Irrigation will begin at station 1 and end at the last station programmed. This is a simple way of programming if only one station at a time is being irrigated. More space is left in the screen for displaying the status of the filter and Chemical injection programs.

2. What is a Group Irrigation Program.

1. Is a very simple method when many stations are to be programmed to be operating at the same time, without the need to have many overlapping programs which are confusing and tedious to program, and require many key entries.
2. A grouping program is easily visualized as all active stations are displayed on the screen at the same time. With single station overlapping programs, this is not so.
3. Any station can be in one or a number of groups.
4. If any Filter or Chemical injection stations are not used, these can be included in a group program.
   e.g. if only 2 filter stations used (i.e. 26, and 27) stations 28 and 29 can be used in the irrigation program.
   If chemical injection is not used, stations 30,31 and 32 can also be used for irrigation
   if no filter or Chemical injection, the controller can be configured as 32 grouping stations
5. A group may contain no valves. i.e. As a program delay, in this situation the pump will be shut down. i.e. if in minutes mode = 9999 minutes = approx. 1 week.
6. If several pumps are used, and different pumps are required during irrigation, the pumps can simply be loaded into the groups with the valve stations.
   When the group of valve stations is switched on, the pump will be switched on at the same time.

If the Runtimes of the stations are the same the programming is very simple. The diagram following is an example when the Runtimes are not the same, but illustrates the very simple method of programming. Note that at any stage of programming or irrigation, the valve numbers are always displayed on the screen.



TYPICAL PROGRAM ILLUSTRATING OVERLAPPING STATIONS & DELAYS

3. How to Program a Group.

Group 1 will operate for 75 minutes and valves 01,19,25,08,17, and 03 will be switched on for this period..

Simply enter a runtime and then allocate the valves that will be switched on for this time.

The group runtime is set to the station with the minimum runtime, and the other valves with a

```
PROG 5 GROUP 1      = 0075m
  01 19 25 08 17 03 00 00
```

longer runtime are carried over into the next group.

Group 2 will operate for 30 minutes and valves 15,19,25,07,17, and 03 will be switched on for this period..

```
PROG 5 GROUP 2      = 0030m
  15 19 25 07 17 03 00 00
```

Group 3 will operate for 60 minutes and valves 15,19,25,07,13, and 03 will be switched on for this period..

```
PROG 5 GROUP 3      = 0060m
  15 19 25 07 18 03 00 00
```

This can be a combination of any stations on the controller up to a maximum of eight.

Group 6 will operate for 60 minutes with no valves programmed. The pump will be switched off for this period..

```
PROG 5 GROUP 6      = 0060m
  00 00 00 00 00 00 00 00
```

4. Configuration

The **only** difference between a sequential OR a grouping Program is in the allocation of the Runtimes to the stations. In a Sequential Program, a **runtime is allocated to each station**. Irrigation starts at Station 1 and ends at the last station programmed. In a Grouping Program, **a Runtime is allocated to a group (or shift)**. **Up to 8 stations can be entered into this group**. All valves entered in this group will be switched on for the period of the Runtime. When the Runtime counts down to zero, these Stations will be switched off and the valves in group 2 will be switched on. There are up to 25 groups in a program. Irrigation starts at Group 1 and ends at the last group programmed.

During the switch on of valves within a group, a delay (0-99secs) can be set between each valve within a group switching on. In addition the delay can be only within the first group or all groups within the program to aid in the hydraulics of the irrigation.

1. 8 unique programs 1 to 8, with 16 or 25 stations with a Runtime of either
   0 - 9999 minutes (count in 1 minutes increments) or
   0 - 9999 seconds (count in 1 second increments) or
   0 - 9999 Volumetric (count in pulses from a flow meter). Input is programmable for 0-99 pulses / Volumetric unit.

Four Station filter controller with

(1). Pressure differential input or Timed filter program.
(2). Programmable Delay before filter operation at the start of irrigation.
(3). Runtime of each filter station programmable from 0 - 99 mins 99 secs.
(4). Programmable Delay before allowing another filter cycle.
(5). Programmable backup delay in case of Pressure differential switch failure.
(6). Filter inter-station delay. programmable 0 - 99 seconds, allows system stabilise

Chemical Injection Program.

A Premix output for mixing Chemicals during the prewet cycle. (0 - 9999)
First injection output adjustable from (0-9999) mins, secs, or volume.
Delay between primary and secondary injection of (0 – 9999).
If both the Irrigation and Chemical Injection are volume, then the Delay between First and Second Injection will default to (0 - 9999) Minutes.
A **Second Chemical injection** output. (0 - 9999).

Mixing pump duration

Can be set as a percentage of the injection time to prevent pump operating with an empty tank.

Proportional Chemical injection.

The number of chemical injection pulses for each irrigation flow meter pulse can be set to give an even chemical concentration

Accumulative RunTime

Total program Runtime X W Budget is displayed to aid programming.

Multiple starts in Chronological order.

Up to nine starts for each of the programs 1 to 8 can be displayed and sorted into **Chronological order**.

Pump Off Delay (0 - 99 seconds)

May be necessary if slow turn off valves are used.

Delay Before Hold. *(0 - 99 seconds)*

If a pressure or flow sensor is connected across the HOLD input, it can be in the active state at the start of irrigation. To mask this input, the HOLD DELAY can be set to ignore the HOLD input for the period of HOLD DELAY.

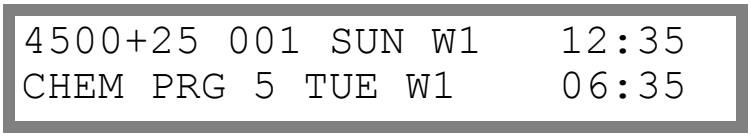
Inter-Station Delay *(0 - 99 seconds)*

For some valves to switch off, full pressure must be applied to the valve. To ensure this, a delay is inserted between one valve switching off and the next valve switching on.

Cyclic Irrigation.

Each program can have 1 – 99 cycles. (0 cycles = no irrigation).

Next Program to start,



Next program to start is program 5 with Chemical injection on Tuesday week 1 at 06:35.

Totalizer

The total of the irrigation and Chemical injection time for each station is displayed. The totals can be set to zero at any time.

Water budget

Adjustment range of 0% to 250% for each program.

Global Rain ON/OFF

Can disable OR enable all programs with Global rain switch.

Permanent memory.

A back-up battery is installed only to retain the clock during power failure.

Auto-Skip delay

Auto-Skip 1 time at the beginning of irrigation and during station change. It then reverts to the Auto Skip 2 time. (0 – 255 seconds).

Time-Zone

Set a time "window" for irrigation to operate within. This enables the user to optimise power costs and water when available.

Fault Reporting.

Monitors flow or pump pressure using two preset auto-skip times. In the case of a malfunction, the controller will log the faulty station, and then step to the next station. The faulty stations can be recalled at any time. The fault will be logged with a **W** to indicate a watering error has

occurred. If an Injection error has occurred a **i** = injection error will be displayed. An Alarm output is switched on to indicate a fault has occurred. If a *Communication options Chip is fitted*, and Radio-Master valves are installed, the fault may be logged as **C** indicating a communication error to the valve.
if a valve draws excessive current in the field, the faulty station is stored in the fault Data Base as **E** = electrical error.

Manual Program Control

Any station or program can be **manually started**., program **advanced** from station to station (or group to group), or the Irrigation can be **paused** from the keyboard.

Plug-in terminal strip.

The valve output field wiring does not need to be disconnected during servicing Simply unplug the terminal strip from relay board when servicing is required.

Sensor inputs

The controller require normally open switch inputs. Inputs are- Reset, Hold, Auto-skip, Program 1 Start input, Program 2 start input, pressure differential input for filter, Pulse Flow input for Irrigation, First chemical injection, Second chemical injection. Rain bucket input, and Alarm out for fault reporting.

Communication protocols

Communication protocols are **RS232** (Direct RS232 **or** UHF Radio **or** Telephone **or** GSM). **OR RS485** (Direct RS485 **or** Radio-master) When communicating over a distance of 50m to 2km, or more than 1 controller use RS485, RadioMaster, UHF radio, Telephone or GSM communications to link the field controllers to the P.C for central programming and fault reporting. Direct RS485 Communications can be in excess of 2km with the use of a RS485 repeater. (*Communication options Chip required for the above functions*).

Rain Sensor

When a Rain sensor is fitted to 1 or more controllers, the measured rainfall can be logged and the results used to Rain-Switch 1 or more controllers within a network, and the resultant action sent by SMS to a GSM or CDMA mobile phone. (*Communication options Chip required*).

Surge protection.

Extensive mains and field **surge protection**. Relay outputs to field valves ensure reliable operation in the most harsh conditions. All Logic powered from an additional isolation transformer and to allow all logic to be tied directly to earth.

Solar power option

Allows a Micro-Master 4500 Plus to generate 24 VAC to operate standard solenoid valves from a 12 volt supply. This prevents cable damage due to corrosive DC current flowing through the cables causing electrolysis. The 24VAC inverter has been designed to have 0 volts DC component.

CHAPTER 2 Familiarization with the controller

Keyboard Basics

As the controller has 8 programs, the numbered keys 0 - 8 are used to both enter numerical data and index Programs 1 to 8. To program one of the following controller functions, press the keys below then a numbered key **PROGRAM 1-8**.

DAY TABLE | RUNTIMES | START TIMES | WATER BUDGET | IRRIGATION CYCLES | CHEMICAL | MANUAL START

When the controller is ready to accept numerical program data, the portion of the display which is to acknowledge and accept the data, will have a flashing cursor. Whilst in this condition the controller will reject non numeric key strokes, except for the ← →, and **END** keys, which will advance to the next program entry or return the controller to the "HOME mode". If an incorrect key is pressed, the controller will issue a prolonged "beep", and wait for further correct input. If an unacceptable large number is entered, the display will register the large number until the ← →, or **END** key is used, then it will reject, (prolonged "beep"), and return the display to the previous entry before modification began, and wait for correct input. When an acceptable keystroke is made, the controller confirms acceptance by a short "beep" and waits for the next key entry.
When numerical data is being entered, the display will continually "roll" from right to left, until the correct entry is made.
Example: If a 00:12 was mistakenly entered instead of 00:32, by pressing **0 0 3 2**, 00:12 would "roll" out of the display and be replaced by 00:32.

When entering the time of day, the controller uses 24 hour military time. Run times are entered in minutes or seconds. i.e. 5 hours is programmed as 300 minutes.

Basic Operation Keys

Among the most important, and by far the most frequently used keys are ← →, and **END** keys, that allow the user to move from one program location to another (in single steps) while "inside" any of the particular program functions. Once you have entered a value, pressing ← →, or **END** will store this entry in **permanent memory** and move onto the next location awaiting a data entry or another program step. When all program data has been entered, a rapid check of the entered data may be made by depressing the ← or → keys and maintaining the pressure on the key pad. This will cause the data value to "roll" through, quickly enabling visual confirmation of program data.

Home Screen

The controller will display:

1. The Model of the controller (ie MM4500+25) or (MM4500+16).
2. If a Communication chip installed, The IDCode will be displayed – Stand-alone =' '.
3. The time of day and day (SUN Week 1 to SAT Week 2).
4. The next Program to start with both Start Time, and the Day of the week.
5. If no valid programs, (NO IRRIGATION PROGRAMMED) will be displayed.
6. If the Global Rain Switch has been set, (ALL IRRIGATION DISABLED).
7. If a power failure (POWER FAIL) will be displayed.
8. If a fault has occurred in the field (SEE REPORTS) will be displayed in the screen.

NOTE: Programming changes may only be accessed when in the controller is displaying the **Home Screen**.

During Irrigation

As the primary directive of the MicroMaster® controller is the irrigation cycle, once started, it can only be interrupted by :

1.The ← key Suspends irrigation program and turns the pump off. Press ← again to recommence the irrigation program at point of suspension.

2. Press the → key to advance the station or group currently in operation to the next station/group in the current irrigation program.

3. **END** key to stop and cancel current irrigation program.

4.Or by an external A-skip, Hold or Reset input.

No Editing of controller programs from the controller keyboard can be carried out when an irrigation cycle is in operation, the controller must be stopped and returned to the HOME mode before editing or viewing procedures can be employed.

NOTE: If the controller is connected or net-worked to an IBM PC, all irrigation programs can be accessed and edited during irrigation.

Audio Feedback Keys (Beeps)

The short "beep" which accompanies all key-strokes and controller actuation is an important programming tool. MicroMaster® controllers are designed so that erroneous and potentially corrupt data cannot be entered into the program.

CHAPTER 3 Controller Programming

3.1 Setting Time and Day

The first step in programming the Micro-Master® controller is to set the current time and day of the fortnight. On initial "power up" the controller will display the default time of 4:00 on Sunday of week one. The controller will also sort through all the start times and day table entries in order to display the program which is to start next. If no programs are entered the controller will display, "NO IRRIGATION PROGRAMMED".

```
4500+25  001  SUN W1  4:00
  NO IRRIGATION PROGRAMMED
```

Press the **SET TIME/DAY** key, enter the current time of day (in 24 hour mode).

Example:
If the current time is 20 minutes to 4 (p.m.), then enter, ***1 5 4 0*** *(15:40 hours).*

```
NEW TIME OF DAY    15:40
Enter time then → key
```

After pressing the → key enter the current day. The MicroMaster® is a 14 day cycle controller and identifies the day and the week. To change the day number from the default SUN W1 use

Example:
To change the day number to Thursday of week one press the → key until THU W1 is showing.

```
TODAY IS SET AT THU W1
PRESS ←→ CHANGE END=Exit
```

the ← → keys and then press the **END** key.

3.2 Required Data for an Irrigation Program

To initiate a watering sequence, the MicroMaster® **MUST** have some valid entries in each of the following 5 tables.

1. **DAY TABLE** - What day irrigation and / or Chemical Injection is to take place.
2. **START TIMES** - What time of day to start watering.
3. **RUN TIMES** - How long each valve is switched on for.
4. **WATER BUDGET** - A percent override of greater than 0%.
5. **IRRIGATION CYCLES** – Default = 1. adjustable from 0 (no irrigation) to 99 cycles.

These may be carried out in any order, depending on preference, without adverse effects.

3.2.1. Day Table - (What day irrigation and Chemical injection is to take place)

DAY TABLE

The Micro-Master® has a DAY TABLE for each irrigation Program (1-8). The table allows each Program to be programmed for up to a 14 day period. The table can set which day irrigation is to take place and whether the irrigation is only irrigation OR if Chemical injection is to take place as well. The irrigation options

No Irrigation
Irrigate Program only
Chemical Inject Program

Example are as follows. - see table below.
To set Tuesday Week 1 to Irrigate and Chemical inject Program 5, press ***DAYTABLE*** *then* ***PROGRAM 5.***

```
TUE W1  CHEM INJECT PRG 5
SETUP=CHANGE    ←→ = DAY
```

Press the → *key until Tue W1. Press* ***SETUP*** *Key until "CHEM. INJECT PRG: is displayed. Repeat until all 14 days have been programmed. Press the* ***END*** *key to exit the program*
. If Cyclic irrigation is required, **See Irrigation Cycles**.

3.2.2. Start Times (What time of day to start watering.)

START TIMES

Up to 9 separate start times can be entered for each of the programs 1 to 8. Maximum cycles / day / program is (9 x 99) = 891 cycles using the **Irrigation Cycles** function.

Entering Start Times

The following example sets two start times for Program 5 to 2:35 and 6:30. This will result in irrigation starting at 2:35 and 6:30 each day if **Irrigation Cycles** >0 and an entry other than ***NO***

Example:
Press ***START TIMES*** then ***PROGRAM 5***. Using the numeric keys, enter the first start time for this program. Press ***2 3 5***. To enter more starts press → and enter the second start time ***6 3 0***.
This procedure is repeated until all required start times are entered for Program 5. Press the ***END*** *key to exit the program.*

```
START 1 FOR PRG 5  =  6:30
Enter time then ←→  END
```

IRRIGATION is entered in the **DAY TABLE** for that day for **Prog 5**.

Automatic Sorting of Start Times. When exiting from the program, the start times will be restored in chronological order. i.e. if the start times were entered as

Start 1	16:30		Start 1	04:30
Start 2	22:30		Start 2	08:30
Start 3	Blank	*these will be restored as*	Start 3	16:30
Start 4	04:30		Start 4	22:30
Start 5	08:30			

NOTE: If consecutive start times are set, which do not allow sufficient time for the completion of the entire irrigation program, those start times will be ignored. Start times will only be recognized when the MicroMaster® is in the home screen.

NOTE: A start time of "00:00" cannot be set. The controller will read this as a non-start. If midnight is to be set, a start time of 23:59 or 00:01 can be used.

Group OR Sequential operation ?
Programming the Runtimes (the time the valves are switched on for) can be set with two different programming methods.
1. *Sequential* - allocating a runtime to each individual output station. Useful when only one valve is on at a time.
2. *Group Programming.* (When more than 1 valve at a time is switched on or non sequential Irrigation is required).
see group or sequential operation chapter 5.6

3.2.3. Run Times (How long each valve is to be switched on for.)

The Micro-Master® supports cyclic Irrigation. Enter the required run time for each station (or GROUP). The total precipitation for each station is selected by the number of cycles multiplied by the program run time.
See **SETUP. - Setting Run Times Sequential mode.**

NOTE: If Program 5 has been setup in Minutes mode, **m** will be displayed
If Program 5 has been setup in Seconds mode, then a **s** will be displayed.
If Volumetric mode selected then a **v** will be displayed.

Example: Setting RunTimes Program 5 in Sequential Operation. *To set run times, press* ***RUNTIMES,*** *then* ***Program 5*** *and enter the required run time in Minutes or Seconds or Volumetric.*
Press the → key to advance to station 2, Program 5. Repeat this sequence until the run times have been set on all stations.

```
PRG 5 RUN TIME 1  =  0125m
Enter time then ←→   END
```

Setting Run times and Allocating Valves in Group Mode

First see Group Setup Operation Chapter 5.6

NOTE: If Program 5 has been setup in Minutes a **m** will be displayed.
If Program 5 has been setup in Seconds, then a **s** will be displayed.
If Volumetric mode has been selected, then a **v** will be displayed.

Example: Setting Run Times for Program 5 Group Operation
To set a run time of 145 minutes and Allocate valves 1,3,8,and 16, press ***RUNTIME,*** *then* ***Program 5*** *and enter the required run time in Minutes or Seconds or Volumetric. ie* ***1, 4, 5.***
Press ***LOAD VALVE*** *The cursor will now move to load the first station.*
Press ***1, LOAD VALVE, 3, LOAD VALVE,***
8, LOAD VALVE, 16 *to enter the stations*

```
PRG5 GROUP 1 TIME = 0145m
 01 03 08 16 00 00 00 00
```

Press the → key to advance to Group 2 Program 5. Repeat until all Run times and valve allocations have been entered. ***END*** *= Exit.*

3.2.3a. Accumulative Run Times (same for sequential or group programming)

The total Run Time for Program 5 is displayed after the last run time is entered
i.e. (Stn. 16 or Stn. 25 if sequential) or (Group 25 if grouping). The current Water Budget percent entry is taken into account when calculating the accumulative irrigation run time.

i.e.

```
RUNTIME X BUDGET = 00545m
PRESS ←→ or END to EXIT
```

Press **END** to return to the home screen.
NOTE 1: Run time settings for controllers initialized in seconds or volumetric mode are the same as above, except a **s** or **v** will be displayed.
NOTE 2: Zero all run times for unused stations or groups.

3.2.4. Water Budget

The irrigation run times can be globally changed for each program using the Water Budget function. The variation is from 0% (program off) to 250%. For example if a run time is 20 mins and a Water Budget of 150% is entered for Program 5, the irrigation time will be 20 mins x 150% = 30 mins.
Note: If Water Budget for program 5 is changed to say 150%, the runtime for the Main and secondary Chemical Injection will also change by 150%. The Pre-wet and Secondary delay will be unchanged.

Entering Water Budget

Example:
To set the Water Budget for Program 5 to 150%,
*Press **WATER BUDGET , then PROGRAM 5**. Press **1 5 0** to enter a Water Budget of 150%.*

```
PERCENT PROGRAM 5 = 150%
Enter 0-250%    END=EXIT
```

*Press the **END** key to exit the program.*

3.2.5. Irrigation Cycles

The Micro-Master® supports cyclic watering. Enter the run time for each station before water run-off occurs. The total precipitation for each station is selected by the number of Cycles multiplied by the program run time. If a delay between repeats is required, simply allocate a runtime to a empty group at the end of the program.
Press the **IRRIGATION CYCLES** key then **Program 5** to enter the number of irrigation cycles for program 5. If 4 cycles of irrigation is required for Program 5 enter **4**. When program 5 is started program 5 will cycle through all stations (or all groups) 4 times before stopping.

```
NUMBER OF CYCLES PRG5 = 04
DEFAULT = 1     END = EXIT
```

During irrigation the screen will now display PRG5 1-4. i.e. first cycle of a 4 cycle irrigation

```
PRG5   1-4  STN  5 = 0235M
 CHEMICAL OFF  F 1 = 01:15S
```

3.2.6. Filter Program (Filter Station 1 = 26 to Filter Station 4 = 29)

The filter program controls four output connectors (Stn 26 - Stn 29) which is used to control back-washing for up to four separate filters, either in response to a pressure differential actuation or simply on a regular time interval.

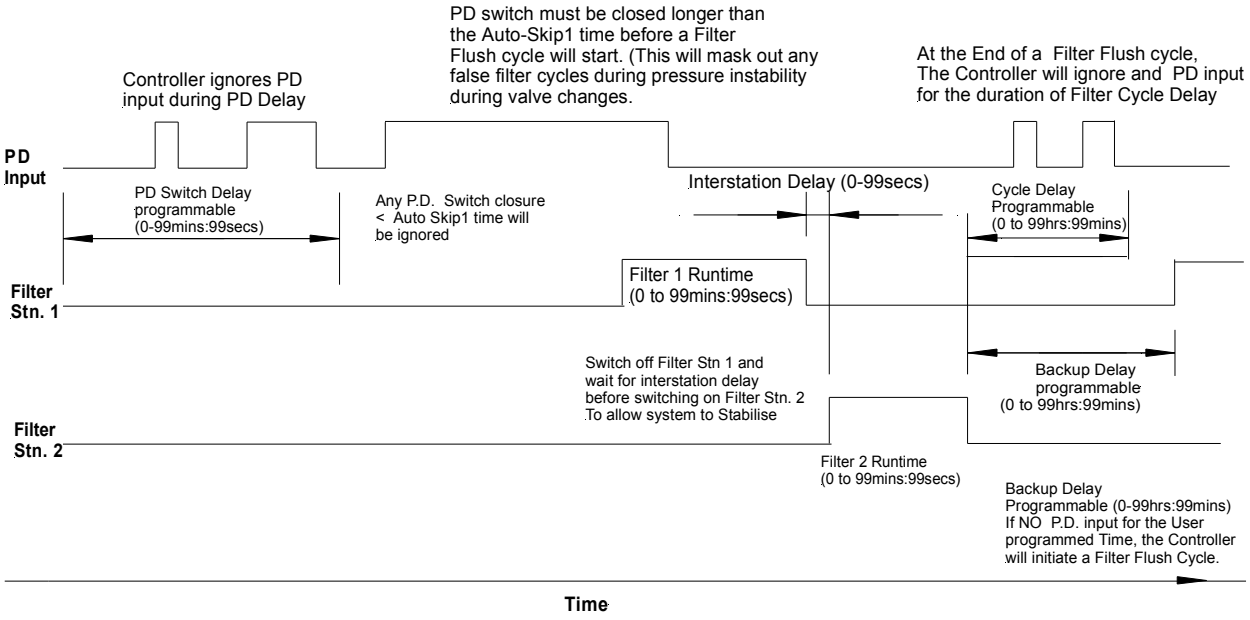
3.2.6.1. Initial P.D Delay – Delay before the controller will look at the PD Sensor.

When an irrigation cycle commences, the Initial PD delay is the adjustable time period before the controller looks at the PD switch to see if a filter cycle is requested. This is to allow the system sufficient time to stabilize before a flushing cycle commences, as further initial de-stabilization may result from a premature filter cycle actuation immediately after pump start. NB. The contacts from the P.D switch must remain closed for the duration of Auto-Skip 1 Time. This is to prevent false filter operation during irrigation when the pressure may vary during station change over.

Example:-To set filter Back-flush Station 1, and 2 to 75 seconds,
Minimum time between back-flush of 2 hrs.
Inhibit Back-flush for 10 minutes at the Start of irrigation,
Maximum time allowed between Back-flush of 5 hrs
Filter inter-station delay of 10 seconds
*Press the **FILTER PROGRAM** key and enter the required back-flush time for filter station 1 enter **7 5***

*Press the → key to advance to **BACKFLUSH STN 2** Press **7 5** Press → key to advance to **FILTER CYCLE DELAY** (Minimum time between back-flush) and Press **2 0 0** to enter 2 hrs.*
*Press the → key - **INITIAL P.D DELAY**.(Inhibit Back-flush for 10 minutes at the Start of irrigation) Press **1 0 0 0** .*
*Press the → key **PD SWITCH BACKUP** (Maximum time allowed between Backflush) and enter **5 0 0** to enter 5 hours*
*Press the → key **FILTER STN DELAY** (Filter inter-station delay, and Press **1 0** to enter 10 seconds. Press **END** to exit program.*

Micro-Master 4500 Plus Filter Flush Timing Diagram


PD switch must be closed longer than the Auto-Skip1 time before a Filter Flush cycle will start. (This will mask out any false filter cycles during pressure instability during valve changes.
At the End of a Filter Flush cycle, The Controller will ignore and PD input for the duration of Filter Cycle Delay
Controller ignores PD input during PD Delay
PD Input
PD Switch Delay programmable (0-99mins:99secs)
Any P.D. Switch closure < Auto Skip1 time will be ignored
Interstation Delay (0-99secs)
Cycle Delay Programmable (0 to 99hrs:99mins)
Filter Stn. 1
Filter 1 Runtime (0 to 99mins:99secs)
Switch off Filter Stn 1 and wait for interstation delay before switching on Filter Stn. 2 To allow system to Stabilise
Backup Delay programmable (0 to 99hrs:99mins)
Filter Stn. 2
Filter 2 Runtime (0 to 99mins:99secs)
Backup Delay Programmable (0-99hrs:99mins) If NO P.D. input for the User programmed Time, the Controller will initiate a Filter Flush Cycle.
Time

3.2.6.2. Filter Cycle Delay – Minimum Time between Filter Flushing Cycles.

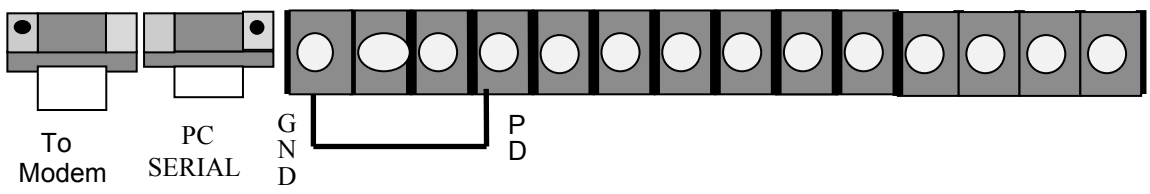
This is the delay time between filter back-flush cycles. It Acts in conjunction with the PD switch and effectively delays a Pressure Differential induced flushing sequence for a period of time to allow system stabilization after the completion of a back-flush Cycle. A typical minimum delay would be 5 minutes when a PD switch is used.

3.2.6.3. P.D. Switch Backup Delay – Max. Time between Filter Flushing Cycles.

The Filter program has a background timer to actuate a filter program cycle if an unusually long time has elapsed between a Pressure Differential initiated back-flush cycle. This guards against filter overload in the event of PD switch failure.

3.2.6.4. Filter Inter-Station Delay – Time between each filter station operating.

This is the time delay between a filter station switching off and the next station switching on. A time between 0 to 99 seconds may be entered. This allows time for the system to stabilize before back-flushing the next filter.



Connect N.O contacts of P.D switch across terminals P.D and Gnd. When no P.D Switch is used, i.e. the filter cycle to be time only operation, the P.D. input must be linked to the GND terminal as above.

3.2.7. Chemical Injection

3.2.7.1. First Injection *(Terminal 30)*

Two separate chemicals may be injected into the irrigation system using this Program. The first (primary) injection is most commonly a fertilizer material. This injection time setting is adjustable in the range 0 - 9999 seconds, 0 - 9999 minutes or 0 - 9999 volumetric units for each station or Group of the irrigation.

3.2.7.2. Second Injection *(Terminal 31)*

The second injection, usually a trace element, a water treatment measure (pH control, chlorination etc.), or alternative fertiliser. This injection time setting is adjustable in the range 0 - 9999 seconds, minutes or volumetric units for each station or Group of the irrigation.- (units same as first injection).

3.2.7.3. Pre-wetting / Mixing Time *(Terminal 32)*

The delay between station or Group start and the injection, is to allow sufficient time for agitation of dissolved chemicals and a degree of soil pre-wetting to aid in the dispersal and penetration of the chemical into the soil. This duration is (of 0 - 9999 minutes or 0 - 9999 seconds). If Chemical Injection is volumetric, the Pre-wet / Mixing time will use the units of the First Injection.

3.2.7.4. Delay between First and Secondary Injection

Certain chemicals and fertilizer materials are incompatible. o allow the second chemical injection to take place towards the end of a station or Group Runtime, (as with maintenance chlorination), a delay can be entered (1 – 99 % of the irrigation Runtime or Volumetric units) to separate the First and Secondary injection for a station or group. This delay is set for each program and is constant for all active stations or groups within that program. Ie if delay = 2% and Runtime = 220 minutes then the delay will be 4 minutes (ie corrected to nearest minute). If Runtime was 240 volumetric units then delay would be 4.8 units rounded up = 5 volumetric units.

Example of setting up Chemical Injection

Example:
First Irrigation and Chemical Injection is Volumetric
Set First Injection Station 1, to 50 Volumetric units
Set First Injection Station 2, to 125 Volumetric units
Set Prewet / Mixing Time , to 2% of Irrigation Volumetric units.
Set Delay between Main and Secondary inject, to 3% Irrigation Volumetric units.
Set Secondary Injection, to 105 Volumetric units

*Press **CHEMICAL***
The screen will then prompt the user to select program 1 or 8
*Press **PROGRAM 5***
*Enter the required Main Injection for station or Group 1 enter **5 0***

```
PG5 CHEM1  STN  1 =  0050V
Enter Time then ←→   END
```

*Press the → key to advance to **INJECT 5 STN 2** Press **1 2 5***
to enter 125 injection volumetric units
*Press → key to advance to **PREWET / MIXING** (time to mix and allow prewet) and*
*Press **2** to enter **2%** of volumetric units.*

```
PREWET % of R/Time  = 002 %
Enter Time then ←→    END
```

*Press the → key - **DELAY % of R/Time**.(delay between First and second injection)*
*Press **0 0 3** to enter 3% of the irrigation volumetric units before start of secondary injection.*
*Press the → key **SECOND INJECTION** (Time/volume for secondary injection) and enter 3% of volumetric units.*
*Press **END** to exit program*

3.2.8 Rain Switch – Stand alone operation

To disable irrigation (Rain Switch), the **RAINSWITCH** key can be used to disable all irrigation on **ALL** Programs for an indefinite period until re-enabled.

Example:

To disable all irrigation, press **RAINSWITCH** key.

```
ALL PROGRAMS ENABLED
→ = CHANGE    END=EXIT
```

Press the → keys to enable or disable all irrigation. Select disable irrigation. The screen will display Irrigation Disabled.

```
MM4500+25    SAT W2   4:24
IRRIGATION DISABLED
```

. The controller will remain disabled until the rain switch is changed from the keyboard.

3.2.9 Rain Switch and Rain Bucket

Enable the rain switch is the same as for stand-alone operation or can be downloaded from the central. The controller will remain disabled until the rain switch is removed either from the keyboard or commanded from the central.

```
MM4500+25    SAT W2   4:24
DISABLED BY RAINSWITCH
```

If a rain bucket is installed at this controller and the rainfall Exceeds RAINFALL CANCEL, then the following screen will be displayed indicating the actual rainfall and the limit that was set to disable irrigation.

```
MM4500+25    SAT W2   4:24
RAIN   8 /RAIN CANCEL   5
```

The irrigation will be disabled Until the rainfall in the logging period drops below the RAIN CANCEL value or the log is cleared from the central or at the keyboard by pressing the REPORTS key.

If both the RAINSWITCH and the RAIN CANCEL are active, the following screen is displayed.

```
MM 44500+25 SAT W2   4:24
RAIN= 8/CANCEL= 5+SWITCH
```

The controller will remain disabled until both the RAINSWITCH
Is removed and the rainfall in the logging period drops below the RAIN CANCEL value or the log is cleared from the central or at the keyboard by pressing the REPORTS key

3.3 Sensors

3.3.1 Rain Bucket

The controller can also be setup to cancel irrigation if the accumulative rainfall in a defined period (between 1 to 7 days) exceeds a predefined precipitation.
This function requires a rain bucket sensor connected to the input to one or more field controllers. If the system is under Central control, a controller fitted with a Rain-bucket sensor can Rain-Switch controllers within a group or all controllers in the system. The Central would then report the action to a mobile phone with SMS.
The Controller counts the number of precipitation pulses and logs the total every hour. The log period can be set for a period of 1 to 7 days.
If a period of 3 day is selected, rainfall will stay in the log for a period of 24 hours before being "over written" 72 hours later by a new sample. If the rainfall was greater than the precipitation defined in Cancel Irrigation threshold, then the controller will disable all irrigation, and set the Rain Switch on.
No irrigation will take place until the total precipitation within this 24 hour Window falls below the Cancel Irrigation Threshold, (i.e. if no more rain occurs). The Rain switch will then be switched OFF and irrigation will continue when programmed.
Each event of the Rain Switch being turned ON or OFF by the Rainfall can be programmed to be transmitted to the Central. If the log period was set to 7 days, then irrigation could be disabled for up to a period of 1 week.
Rainfall Cancel can be entered from the Central or from the controller.
Press the **SENSORS** key.

```
RAINBUCKET 1    AUTOSKIP 2
FLOW SETUP 3     END=EXIT
```

Press key 1 and the following screen is displayed.

```
RAINCANCEL 1    PULSE/mm 2
LOG 3  RAIN 4    END=EXIT
```

Press key **1** to enter the accumulative rainfall that the controller Rain-switch will activate to cancel further irrigation.

```
RAINFALL CANCEL MM    =  8
Rain INPUT          END=EXIT
```

Press **END** to return to enter other Rain-bucket parameters.
Press key **2** to enter the calibration pulses per mm of rainfall for the Rain-Bucket.

```
NUMBER OF PULSES MM =  10
Rain INPUT          END=EXIT
```

Press key **3** to enter the logging period to accumulate rainfall.
The following screen is displayed.

```
AVERAGE RAIN DAYS     =  5
LOG=1-7 DAYS      END=EXIT
```

Enter the logging period between 1 to 7 days. The rainfall cancel has now been setup.
Press **END** to return to enter other Rain-bucket parameters

Press key 4 to display the length of the logging period with the accumulative rainfall for this period. The log can be cleared by pressing the **0** key. This will clear the log and set the

```
5 DAY TOTAL RAIN  =  12MM
0=CLEAR LOG       END=EXIT
```

accumulative Rainfall to 0 and turn the automatic rain switch off to Enable irrigation.

3.3.2 Setting The Auto-Skip Delay Times

The Auto-Skip function enables the controller to monitor specific conditions. e.g. If either the Pressure or Flow fall outside the required parameters during irrigation, then the valve station currently irrigating can be canceled, the faulty station recorded, and irrigation switched to the next station, before this condition becomes potentially dangerous or unstable.

The most common application of the Auto-Skip function is to monitor the condition of a normally open, high/low pressure switch (or flow switch) installed in the system mainline. In the event of a valve not opening (high pressure and no flow) or a pipeline rupture (low pressure and high flow) the controller will permit the condition to persist for a pre-set time. If this time exceeds the Auto-skip time, the controller will then advance to the next programmed station or group. When a fault occurs, the faulty station is recorded in the controller, the alarm output is actuated, and the fault is reported if connected to an IBM PC either direct link or via a telephone or GSM modem, Radio-Master, or Direct communications at the end of the irrigation cycle.

To permit the system to stabilise after initial start-up, mainline filling, air evacuation etc., two separate Auto-Skip times can be programmed into the controller;

"AS 1" which operates only at initial start-up and hold, and
"AS 2" which is the operational scanning time.

To set these Auto-Skip times, Press **SENSORS** then press key **2**.

```
AUTO-SKIP 1(0-250) = 020
TIME SECS → OR END=EXIT
```

Use the numerical keys to set the first Auto-Skip time (Range - 0-250 secs).
Now press the → key to enter the scan time for the Auto-Skip 2 time.
(Auto-skip 2 time will generally be a lower value than Auto-Skip 1 time.)
Press **END** to exit.

3.3.3 Flow Pulse Meter Setup

Press the **SENSORS** key**,** then **key 3** to Setup the Irrigation Flow Meter 1.
Press key **1** to select the setup for the irrigation Pulse Meter. (Flow meter 1)

```
Flow1 =1  Flow2=2  Flow3=3
Read/Reset FlowMeter   END
```

Enter the calibration for flow meter 1. In this example it is 1 pulse per cubic meter.

```
PULSES/UNIT VOLUME =  1
Enter Pulses      END=UNITS
```

Press **END** then **>** to Setup the flow-rate units for this sensor. The following screen will be

```
Litres< 1   10L  2 100L  3
CMetres  4        END=EXIT
```

displayed. Select Key 1-4 to choose the units for the flow meter. The < will indicate the current setting selected for the units. **END** to Exit.

Setting up Chemical Injection flow meters.

The setup for the 2 chemical flow meter inputs can be setup in the same way by selecting 2 to select flow meter 2 (Chemical injection 1 Flow meter) and 3 to select flow meter 3 (Chemical injection 2 flow meter).

3.4 Entering Radio-Master Data

Press Key **ID CODE** to enter radio valves. The following screen is displayed.

```
VALVES ON/OFF 1   VALVES 2
REPEATERS 3        END=EXIT
```

After all radio valve data has been entered, radio valve operation can be turned on and off by pressing key **1** from this screen. Press key **1** to enable radio valves. The screen will change to **EnableRadioValves 1.**

```
 DisableRadioValves 1   END
 CloseAllValvesOFF  2   END
```

For the controller to go through a close all Radio valve sequence at the end of an irrigation, CloseAllValvesON must be selected. This is done by pressing Key 2. Key 2 will toggle the close all radio valves ON and OFF.
Press key **2** to enter the IDCode and the node output number (1-4) for this station.

```
STN  1 TO O/P 3 OF   13247
END  <PREV  NXT> SETUP=CLR
```

In the above example station 1 of this controller is connected to output 3 of Radio-Master node that has a radio address of 13247.
Press **>** to go to the next station.
Press **<** to back to the previous station.
Press **SETUP** to clear data for this station
Press **END** to exit from this function.
If any of these stations require a repeater press key 3 to enter this data.
The following screen is displayed when entering a radio repeater for station 1.

```
STN 1 REPEATER      = 47763
END <PREV  NXT> SETUP = CLR
```

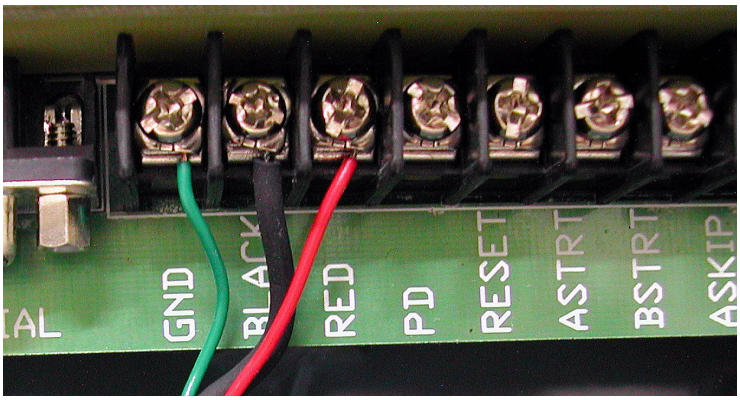
Press **>** to go to the next station.
Press **<** to back to the previous station.
Press **SETUP** to clear data for this station
Press **END** to exit from this function.

Over-View of Radio-Master.

There are 3 specific RadioMaster Spread Spectrum 15 channel radio modules. The have been specially designed to suit the formatting of the Micro-Master and feed back to the controller the status of the valve actuation. The information sent back and displayed and written to the log are

Status of communication , valve operation, Node battery voltage, temperature and signal strength.
RM100 – Central Radio. This is connected to the Central P.C computer.
RM200 – Slave. This is connected to 1 or more Micro-Master 4500Plus controllers and used to connect to the Central Radio or communicate to field Nodes (RM400)
RM400 – Field Nodes. This is installed in the field and is used to actuate up to 4 irrigation valves. The above 3 Radio-Master types of radio can act as a repeater for any other radio in the system. The maximum number of repeaters is 1.
When a Central system is ordered, communication chips for each controller must be ordered (part No. CMM4000301). Radio-Master can be easily Installed or changed from the keyboard of the Micro-Master controller

The RM200 is supplied with 1.5m of attached RS485 cable for connection to the Micro-Master® controller. Pass the RS485 cable through the large hole at the bottom centre of the controller case. Strip the red, black and green wires of the cable. Insert the RED wire under the screw labeled Red on the terminal block. Insert the BLACK wire under the screw labeled Black on the terminal block. Insert the GREEN wire under the screw labeled Gnd. on the terminal block.



Connect the plug pack connector to the socket on the bottom edge of the RM200. Plug the RM101 plug pack into an available 240Vac wall socket.

CHAPTER 4 Controller Operation

4.1 Semi-Automatic Operation

To manually start Program 5 press **MANUAL START** then **PROGRAM 5**.
NOTE: During Semi-Automatic operation, a check is made of the **Day Table** by the Micro-Master®. If (no irrigation) is entered for that current day, then a default is set to Irrigation without Chemical injection. i.e. If the Day table was set to no irrigation, then a normal irrigation cycle would occurr and would also obey the Irrigation Cycles setting for this program.
If the Day Table had an *entry other than no irrigation* for that program, then the programmed irrigation will take place. i.e. if the Day Table was **CHEM INJECT PROGRAM** then Program 5 would operate with chemical injection.

4.2 Manual Operation

Example:
*Press **MANUAL STATION** then press → until Station 3 is displayed. Press **SET TIME** within 2 seconds.*

```
STN. 3 RUNTIME =   :25
  ENTER RUN TIME THEN END
```

*Press **2** then press **5** to enter 25 minutes. Press **END**.*

```
TIME LEFT STN 3  =   :25
```

The Run Time will now count down to 0 and then return to the home screen, or press END to cancel irrigation.

4.3 Manual Operation with Radio-Master

The **MANUAL STATION** function bypasses **ALL** programmed information and simply activates the pump and one valve output and allows the Status of a RadioMaster valve operation to be displayed.
The **MANUAL STATION** key is used when:
4.3.1. **Simple 'on - off' station operation is required**.

Example:
To manually switch on Station 3, press ***MANUAL STATION****.*

```
MANUAL TURN OF VALVE 1
SET TIME <-> & WAIT 2 SEC
```

There is a 2 second delay before the valve is switched on to prevent valves being actuated when pressing the → key.
Press the → key until the required station is displayed. Wait 2 seconds and the valve will switch on. The screen will now display:

```
MANUAL TURN OF VALVE 3
TURN ON RADIO VALVE 3
```

If a RadioMaster valve is connected to station 3 then the above message will be displayed. When connection has been made the screen below is displayed.

```
STN 3 ON PRESS END,<->
TX=OK,O.C,B=12.8,S=45,T=25
```

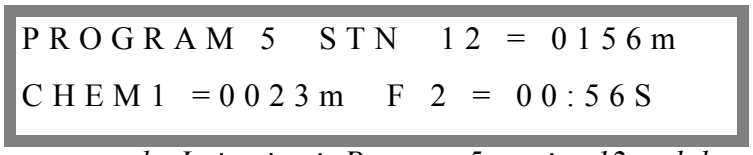
TX=OK – Transmission to the valve is OK. If transmission fails then the screen Will display "TX Radio Valve 3 = Bad'.
The next 2 characters will define the valve operation.
XX = RM400 without Posi-Sense, OK = operation OK, S.C = Short circuit, O.C = Valve open circuit, N.O = Valve did not operate – stuck open or closed.
Battery Voltage B = 12.7V. – Without Posi-Sense = B=XX
Single Strength = SS=45db. (SS > 18 = good)- Without Posi-Sense = B=XX
Temperature = T = 25 ℃ – Without Posi-Sense = T=XX

a manually actuated valve will remain active until advanced using the → key, or canceled using the ***end*** *key.*

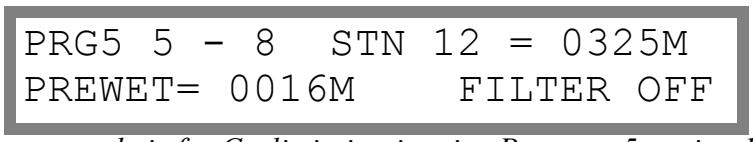
4.4 Screens During Irrigation.

4.4.1. Sequential Mode

A typical screen display during irrigation would be



In the above example, Irrigation is Program 5, station 12 and the remaining Runtime is 156 minutes. Time remaining on main chemical injection is 23 minutes. Time remaining Filter station 2 is 56 seconds.



The above example is for Cyclic irrigation. i.e. Program 5 station 12 and currently in the fifth cycle of an 8 cycle irrigation.
The Chemical injection is in the pre-wet/ premix cycle and the filter program is OFF.

4.4.2. Group Irrigation Mode

During irrigation the format of the screen will optimise the information displayed.

In this screen only 2 valves are irrigating so there is room for IRRIG 21 22

```
PG 5 22 =1234m  FILTER OFF
IRRIG 21 22   PREWET= 0016M
```

Filter will display filter station and time left for filter.
Chemical injection will display chemical status and time/volume remaining.
Irrigation will display time/volume remaining.

```
PG 5 13= 0325M F 1 =00:35S
12 21 24 15    CHEM1= 0016m
```

In this screen there are 4 valves so IRRIG has been omitted. The screen displays Program 5 group 13 valves 12, 21, 24 and 15 are ON. Filter Station 1 has 35 seconds remaining and Main Chemical Injection has
16 minutes remaining.

```
PG 5 18 =0325v F=1   CHEM1
8 12 16 22 13 18 23 14
```

In this screen all 8 valves are switched on and this requires the entire bottom line. The information is now more abbreviated.
The screen displays Program 5 Group 18, 325 volumetric units remaining.
Filter status is Filter station 1 operating. Chemical Status is Chemical injection 1 is active.

```
FLW= 850 l/m   F 2 = 00:45S
IRRIG 23 12    C 1 = 0016m
```

If the controller is irrigating with a pulse flow meter, Pressing the **SETUP** key will display the current flowrate i.e. 850 l/m. Press the SETUP key again and the flow remaining screen will return.

```
P5-1-3 =0850m  F 2 = 00:45S
IRRIG 23 12    C 1 = 0016m
```

The above screen displays Program 5 Group 1 and this is the third cycle of irrigation and 850 minutes left on this group.

CHAPTER 5 Controller Set Up Functions

The **SET UP** key allows for the following tests and set up functions of the controller.
The Set Up is stored in permanent memory and is not lost in the event of a power failure and no standby battery.

5.1. Clear All Programs and Set All Values to Default Mode.

Press **SETUP**. Then press **1** to select **Clear programs**. A warning will be given that all program locations will be cleared. Press → to continue.

```
CLEAR PROGRAMS     KEY 1
DIAGNOSTICS 2 SETUP=More
```

All Programs will now be cleared and the following defaults set

Day	Set to Sunday week 1
Time	Set to 4:00 am
Group Sequential	Set to Group mode
Programs 1-8	Set No Irrigation
Program 1-8 Run-times	Set to 0 minutes
Program Day Tables 1-8	Set to no Irrigation
Chemical Injection Programs 1-8	Set to 0 minutes
Program 1-8 Start Times	Set to 00.00 i.e. no starts
Filter back-flush Runtimes	Set to 0 minutes and seconds
Filter Initial Delay before Filter	Set to 0 minutes and seconds
Filter delay between Cycles	Set to 0 minutes and seconds
Filter Backup Timer	Set to 0 hours and minutes
Filter Inter-station delay	Set to 0 seconds
Auto Skip 1 Time	Set to 20 seconds
Auto Skip 2 Time	Set to 20 seconds
Water Budget Programs 1-8	Set to 100 percent
Global Program ON / OFF	Set to ON
Flow Input sensors	All set to 1
Pump Off Delay	Set to 0 seconds
Delay before Hold on	Set to 0 seconds
Inter-station delay	Set to 0 seconds
Identity Code	Set to 1
Alarm	Alarm Output
Mixing pump duration	Set to 100%
Injection Concentration control	Set to Off
Valve On control within a group	Set to Off
Rain Bucket Parameters	All Set to 0.

When the Communication chip option is installed.

Modem / Serial Link PC	Set to Serial Link PC RS232
Phone Numbers	Set to blank
Transmit Error Messages back to Central	Set to Off

5.2 Self-Test Diagnostic Procedures

5.2.1 Serial Port Test (Tests serial port communications)

A “loop Back “ plug is supplied with the Micro-Master 4500+ Central Software. T0 test the Serial port, Press 2 for diagnostics then key 2 for communications test. The following screen is displayed.

```
LINK PINS 2-3 8-4 SERIAL
Press → = G0   END=EXIT
```

Connect the loop back plug to the connector labeled IBM Serial. Press the → to continue the test. Four short beeps will indicate a good port. Long beeps indicate a bad port. If there is a Bad port contact your Toro AG dealer.

5.2.2 Controller Test

The following checks are made during the Controller Self Test Diagnostics.

5.2.2.1 Program Memory Check

Initially the controller checks the program memory. i.e. the EPROM memory that runs the MicroMaster® program and the RAM that holds the user programs. If the memory is faulty, the screen will display the following,

```
PROGRAM MEMORY ERROR
   CONTACT  DEALER
```

5.2.2.2 Key Pad Check

When each key is pressed, a short "beep" will sound, and the key name will be displayed. If a key does not work, return for service.

```
KEY TEST = WATER BUDGET
PRESS END KEY LAST
```

Press Keys in any order but press the **END** key last to terminate the keyboard test

5.2.2.3 Output Relay Check

After the above sequence is completed and the **END** key has been pressed, all output relays are activated in sequence as the output number is displayed on the screen. The relays can be heard to click on and off twice as the controller cycles through each station. After all valve outputs (1-16) or (1-32), the Pump Start will be activated. The controller then switches on the Alarm output relay. If any relay fails, return for service.

```
CHECK VALVE OUTPUT No.14
RELAYS WILL CLICK TWICE
```

5.2.2 4 Input Check

This requires a length of insulated wire approximately 150 mm long with the wire stripped bare for 5 mm at each end. One end is to be connected to the GND connector at either end of the input connector strip. To Cancel test press the END key.
The screen will display,

```
SHORT ASTRT INPUT TO GND
TO CANCEL TEST PRESS END
```

Touch the free end of the GND wire to the ASTRT input. – Program 1 Start.
There will be a short confirmation beep and the screen will now display
BSTRT - Program 2 Start.
Repeat operation as above.

Repeat for	RESET -	Reset Input
	HOLD -	Hold Input
	ASKIP -	Auto-Skip Input
	PD -	Pressure differential Input
	FLOW1	Irrigation pulse flow meter input.
	FLOW2	Chemical Injection 1 Pulse flow meter input
	FLOW3	Chemical Injection 2 Pulse flow meter input
	RAIN	Rain bucket sensor input

The test should stop at each input test and should not proceed until that input is shorted to GND. At the end of the input test the controller will then give 4 short beeps to indicate clock operating and return to the home screen.

If a controller fault is suspected, this test procedure should be performed first with the system circuits connected, and again (if the fault persists) with the system circuits disconnected. Control system malfunctions are often attributable to operator or external system error.

5.3 Setting Program Time Base to Minutes , Seconds, or Volumetric

Press **SETUP** key until **UNITS KEY 1** is displayed. Press **1.**

```
IRRIGATION KEY 1
INJECT KEY 2    END=EXIT
```

To set the IRRIGATION time base to Minutes, Seconds or Volumetric press Key **1**.

```
SECONDS  1, MINUTES<  2
VOLUME   3        END=EXIT
```

Press Key **1** to select SECONDS mode , **2** for MINUTES. and **3** for VOLUMETRIC mode.
The controller will confirm the change with the < pointing to the current selection.
When Chemical Injection is selected, two options are given.
1. *Volumetric mode.* Chemical injection 1 and 2 input is flow inputs 2 and 3.
2. *Time Mode.* The Chemical injection will count in the same units as irrigation.
NB. If the irrigation mode is Volume, then Chem. injection will default to minutes.

5.4 Program Delays.

Press **SETUP** key until **DELAYS 3** is displayed. Press **3.**

Use **Delays** to program Pump Off Delay, Hold Delay, Inter-Station Delay,
Inter–Group and Delay between valve actuation within Group.

5.4.1 Pump Off Delay.

This is a delay adjustable between 0 and 99 seconds.

```
DELAY FOR PUMP OFF  =  10s
Time in Seconds  END=DELAY
```

Pump Off delay is necessary if valves with a slow turn off characteristic are used, i.e. hydraulic valves.
e.g. if a delay of 10 seconds was set, the pump would be kept running 10 seconds after the last valves was switched off. This would ensure the valves have time and pressure to switch off at the end of the irrigation. The mainline will not drain or have additional valves open at the start of the next irrigation. During pump delay the screen will display

```
WAIT FOR PUMP OFF  =  05s
 Press END = Cancel Delay
```

NOTE: To switch off Pump before end of delay press the END key

5.4.2 Delay Before Hold.

If a pressure or flow sensor is connected across the HOLD input, the switch can be in the active state at the start of irrigation. To mask this input, the HOLD DELAY can be set to ignore the signal from the HOLD input for the period of HOLD DELAY.
e.g. If Hold delay set to 15 seconds, the hold input will be ignored for 15 seconds at the start of irrigation.

```
DELAY BEFORE HOLD  = 15S
Time in Seconds END=DELAY
```

5.4.3 Inter-station Delay

For some valves to switch off, full water pressure must be applied to the valve. To ensure this, a delay must be inserted between one valve switching off and the next valve switching on.

```
  INTER-STATION/GROUP=  10
  Time in Secs.  END=DELAY
```

The Inter-Station delay (0-99 seconds) is common to both programs. For example if a delay of 10 seconds is entered, a 10 second delay will be inserted between each station or group change during irrigation.

5.4.4 Delay between each valve switching On within a group

Press 1 to enable delay switch On valve within Group 1 only.
Press 2 to enable delay switch On valve within All groups.

```
GRP1 ONLY  1  ALL GRPS<  2
TIME DELAY 3       END=EXIT
```

Press 3 to enter the required delay between each Valve switching On. The following screen is displayed

```
DELAY WITHIN GROUP   = 08S
TIME IN SECS      END=DELAY
```

Enter the delay between valve switch On. To Cancel delay between valves switching On enter 0 seconds

.

5.5 Multiple functions of the Alarm output

The 4500Plus can program the ALARM output to be one of three possible functions.
Press Setup until **ALARM O/P 2** is displayed. Press key 2 to select the alarm setup function.
The following screen is displayed.

```
INVERTER<  1    ALARM   2
MASTER/SLAVE  3  END=EXIT
```

5.5.1 Inverter control.

Press key 1 to select the ALARM output (The back arrow will indicate this function has been selected) to control a 12 volt DC to 24VAC inverter. This has been specifically designed to have no DC component in the 24VAC output. This eliminates wiring problems due to electrolysis. In this mode the controller will switch on the inverter during irrigation. For Full information see *7.8 Solar operation*.

```
INVERTER KEY< 1    ALARM  2
MASTER/SLAVE 3    END=EXIT
```

5.5.2. Alarm Output Function.

Press key 2 to select Alarm output. When the Auto-Skip function is actuated due to a fault or sensed conditions, the alarm output terminal is switched to GND to allow an external Alarm, light or an external Auto dialer to be switched on. For Full information see *7.5.8 Alarm Output*.

5.5.3 Master / Slave Function.

Press key 3 to Select this as the **Master** slave trigger. (The back arrow will indicate Master/Slave has been selected) . In this mode the Alarm output will close the Alarm output terminals for approx. 2 seconds before the completion of Program 1. The **ALARM** output of the Master can now be directly connected to the **ASTRT** or **BSTRT** of the slave controller as in the diagram at **Section 7.5.1.**
Note: The **Day Table** and Runtimes on the slave controller must be programmed (no Start Time is necessary) for the Slave to operate. The **Day table** entry allows the Slave program to operate only on those days required by the user. To indicate that 1 controller is the master the + of the 4500+25 changes to 4500M25 to indicate that this controller is the **Master**.
For Full information see *7.7 Master/Slave operation*

5.6 Group or Sequential Irrigation

Press the **SETUP** key until the screen displays

```
GROUP/SEQUENTIAL     KEY 1
PAUSE CHEM 2   SETUP=More
```

Press key **1** to select Group Irrigation or Sequential Irrigation.

```
GROUP CONTROL<  1
SEQUENTIAL   2  END=EXIT
```

Press key **1** to Setup group control irrigation or Key **2** to Setup Sequential Control
The < will indicate which option has been selected.

5.7 Inhibit or Enable Chemical Injection During Filtration

Press **SETUP** until **PAUSE CHEM 2** displays(as above), press **2,**

```
FILTER-PAUSE INJECT<   1
INJECT WHILE FILTER    2
```

Select **Key 1** to inhibit Chemical injection during a filtration cycle.
Or **Key 2** to select Chemical injection to occur during filtration
The **<** will indicate which option has been selected.

5.8 Proportional Chemical Injection

Press **SETUP** until the following displays.

```
PROPORTIONAL INJECTION 1
INJECT ON   2   SETUP=MORE
```

When the communication chip is installed the above screen is displayed. This is to enable communication, Phone numbers and I.D Code to be installed. (See 5.9 – 5.11).
*In the Stand-alone version **Setup=More** is replaced by **End=Exit**.*
Press Key 1 to program the number of chemical pulses required for each pulse from the main irrigation flow meter. Press key 2 to toggle between Inject **ON** and Inject **OFF**.

5.9 Communications Protocol

Only applicable if central software and communications chip is installed.
If a Central computer is used, the only data to be entered **is Enable Central Radio Mode**. All other information can then be down loaded from the central.
Press the **Setup** key until the following screen is displayed. Note: back arrow indicates current setting.

```
PHONE 1    GSM 2  RMASTER 3
RS232<4    RS485 5    SETUP
```

5.9.1 Telephone Communications

When Key **1** is pressed, programming communications to the controller will be by telephone modem through the (IBM serial 9 pin Male D connector) labeled MODEM. When the controller downloads error messages back to the Central computer, the controller will dial the phone number entered in the controller. See 5.10 - **Enter Phone Numbers**. Note: The Telephone modem must be setup before installing. The Toro telephone modem (part No. 1013536) is pre-programmed to suit the controller.

5.9.2 GSM Communications

When Key **2** is pressed, programming communications to the controller will be by GSM modem through the (IBM serial 9 pin Male D connector) labeled **MODEM**. When the controller downloads error messages back to the Central computer, the controller will dial the phone number entered in the controller. See 5.10 - **Enter Phone Numbers**.
Note: The GSM modem must be setup before installing. The Toro GSM modem (part No. 1013581) is pre-programmed to suit the controller.

5.9.3 Entering Radio-Master Data into Micro-Master.

When Key **3** is pressed the Radio-Master screen is displayed.

```
 CENTRAL RADIO IDCODE   1
REPEATER IDCODE 2  END=EXIT
```

When option 1 is selected the following screen is displayed.
Enter the Radio-Master I.D. Code printed on the bottom of the radio. The following I.D. Code entry screen is displayed as below.

```
CENTRAL RADIO ID   = 12345
ENTER 5 DIGITS    END=EXIT
```

If communication to this controller requires a repeater radio, enter the address the same as for the main radio. Address 0 indicates no radio

5.9.4 RS232 Communications

When key **4** is pressed, the communication is setup for direct communications by RS232 (IBM serial 9 pin female D connector) labeled **IBM SERIAL**.

5.9.4-1 RS232 Communications – VHF Radio

When communications is required for a high powered Radio the controller has been setup to interface with a **GME Kingray** UHF Telemetry / Data Transceiver
model Number **TX3600TN.** In this configuration the radio must be programmed first to meet the protocol requirements of the controller. Radios purchased through Toro Australia will be pre-programmed to directly connect to the controller through the (IBM 9 pin Male D connector) labeled **MODEM**

5.9.5 RS485 Communications

When key **5** is pressed, the communication is setup for RS485 2 wire multi-drop communications, using the RED – Black terminals. They are mounted near the Serial connectors below the keyboard.

5.10 Enter Phone Numbers. And Controller ID-Code.

Only applicable if central software and communications chip is installed.
This section is applicable if a GSM or Telephone modem is installed to this controller.
Press the SETUP key until the following screen is displayed. Enter the controller I.D. Code .

```
I.D CODE CONTROLLER  0005
-> = NEXT          END= EXIT
```

Note if more than 1 controller is in the system, each controller must be setup with a unique identity number and the numbers must be sequential from 1 upwards. The default I.D. Code for each controller is 1 and must be reinstalled after a clear all programs. (the default I.D. Code is 1).
Press Key > to enter Telephone or GSM phone numbers. The following screen is displayed

```
PHONE No.1  12345678
NEXT ->  END  SETUP = CLEAR
```

If no telephone of GSM modems are attached to this controller press END to exit back to the home screen.
If the Central software is installed on one or more computers (ie. Office computer and a mobile lap-top) , up to 3 phone numbers can be entered into the controller.
In the event of a irrigation malfunction the controller will first try to report to the first phone number on the list. If no success it will try the next phone number. And will retry every hour until communication is made. The central will then log the message and make a decision to send a SMS message to a mobile phone.
If a Rain-bucket message is received, then the central may be required to rain switch several other controllers with the network. (see Rain bucket 7.3.13)

CHAPTER 6 Reports

6.1 Irrigation Totaliser Report

The Micro-Master® keeps precise internal records of all irrigation activity during a season or specific period.
To access the Totalizer press **REPORTS**. The following screen is then displayed;

```
TOTALISERS 1      FAULTS 2
FLOW METERS 3     END=EXIT
```

Then press **1**. to select the Totalizer. The accumulated Run time in Minutes, Seconds, or Volume

```
STN  1  RUNTIME  =  99935m
 CEM1= 34567m CEM2= 23456m
```

is displayed for Station 1 irrigation and Chemical Injection.

The maximum run time that can be displayed is 99999 minutes, Seconds, or Volumetric units. The totals may be reset when required by Pressing the **0** key. When the → key is pressed, the accumulated irrigation for station 2 is shown. To view/set all stations press the ← or → key. Press the **END** key to return to the Home mode.

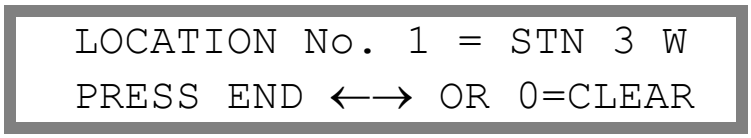
Note:
The format of the report will vary, depending on the Setup configuration of the controller.
Sequential Mode.
Time
The controller will display runtimes for stations *1 to 16* or *1 to 25* depending on the Model.
Volume
The controller will display Volumes for stations *1 to 16* or *1 to 25* depending on the Model.

Group Mode
Time
The controller will display runtimes for stations (1 to 16 and 26 to 32) for the 16 station model. The 25 station model. (station 1 to 32) will be displayed. This is in the event of stations (26 to 32) being used for irrigation. ie not used for filtration or chemical injection.
Volume
When the controller is in Volumetric mode, it is not able to distribute flow to individual stations in the same group. The controller will display

```
GRP  1  RUNTIME  =  99935V
CEM1= 34567V  CEM2= 23456V
```

6.2 Faulty Station Report

An entry into the Fault Table can be caused by
1. The Auto-Skip input.
2. If the transformer current exceeds 2.5 Amps, the station will be skipped and reported.
3.. If a faulty injection occurs, (either proportional or bulk injection)
If a Communication chip is installed then the additional faults will be reported.
4. If a faulty Radio-Master valve is reported, the station number will be displayed followed by a C for communication error. (ie 4C).
All of the above errors will switch on the Alarm output.
To view the fault table, and cancel the alarm output, the faulty station(s) must be cleared.
Clearing each station is achieved by pressing the Key **0** for each fault report**.**
Press the **REPORTS** key.
Press **2** to access the Fault report table.



The first faulty station number recorded, will be shown in the right display. i.e.
station 3. **W** indicating a watering fault occurred at the auto-skip input for station 3. If the display is **STN 3 E** this would indicate an electrical fault i.e. a current > 2.5 amps occurred on *station 3*.
If a faulty injection occurs, (either proportional or bulk injection) the faulty injection station 4. Is reported (ie 4i).

When RadioMaster valves are installed then the controller can displayed. **STN 3C** indicating a communication fault to this valve 3.
After noting this number (if required), press the **0** key to cancel the fault report for this station. **No fault** will now be displayed. Press the → to check for subsequent fault reports. All locations should be checked and cleared by pressing the **0** key. If all faults have been cleared, the alarm output will be switched off when the **END** key is pressed.

6.2.1 Auto-dialler.

The Normally open contact of the Alarm output is also compatible with most auto-dialers e.g. ParaVox or equivalent. The auto-dialler has 4 inputs to report the status of other functions such as Chemical level, pump failure etc.. It can be programmed over the phone and the messages sent to a phone or pager. (see Toro agent).
NOTE: If the fault table has not been cleared, the controller will attempt to irrigate again on the next irrigation cycle for all stations including those where a fault was detected and reported.

6.3 Read / Reset Flow Meters

Press **3** to access the Flow meters report. The following screen is displayed

```
FLOW1=1    FLOW2=2    FLOW3=3
Read/Reset FLOWMETER     END
```

To Read the Total flow measured by the Flow 2 sensor (ie Chemical injection 1) Press key 2. The Following screen will be displayed.

```
 FLOW METER 2 =  000147 CM
 Reset = Key 0    END=EXIT
```

To reset the total to 0 if required, press Key 0. To return to the previous screen press END..
Note:
Flow1 = Flow meter for irrigation.
Flow2 = Flow meter for Chemical Injection 1.
Flow3 = Flow meter for Chemical Injection 2.

CHAPTER 7 Auxiliary Functions

7.1 Time-Zone

The primary purpose of the "Time-Zone" is to allow full use of off-peak power supply, or in areas where water is not supplied on demand. The controller has a separate time zone for each day of the 14 day cycle.
e.g. if an irrigation is over a period of a few days and water is only available between 8 p.m. and 8 am then Time-Zone irrigation will irrigate until 8 am, pause the irrigation until 8 p.m. and continue irrigation until the irrigation is complete.

e.g. Set the Time zone irrigation to pause irrigation at 8 am (08:00)hrs and continue at 8pm (20:00) the following evening on Tuesday week 1. Press ZONE then the → key until Tuesday Wk 1 zone stop is displayed.

```
TUE WK 1 ZONE STOP = 08:00
Enter time then ←→   END
```

Enter ***0 8 0 0*** *for the irrigation to* ***STOP (pause)***.
Press → *to advance to* ***ZONE START***
Enter the Time ***2 0 0 0*** *for the irrigation to restart*
The Irrigation programs will start using start times entered into the controller or a semi- automatic start i.e. press ***Manual Start*** *then* ***Program 1 to 8.***
At the ZONE STOP TIME i.e. 0800 hrs, the program will stop and the screen will display

```
ZONE HOLD   RESTART 20:00
 END KEY TO CANCEL IRRIG
```

Programming Time Zone

The Time-Zone has now been entered for Tuesday week 1. Time-zone irrigation can be entered for other days of the 14 day cycle.
Note:
If either ZONE START OR ZONE STOP 5 time is 00:00 ,then the time-zone will be ignored.

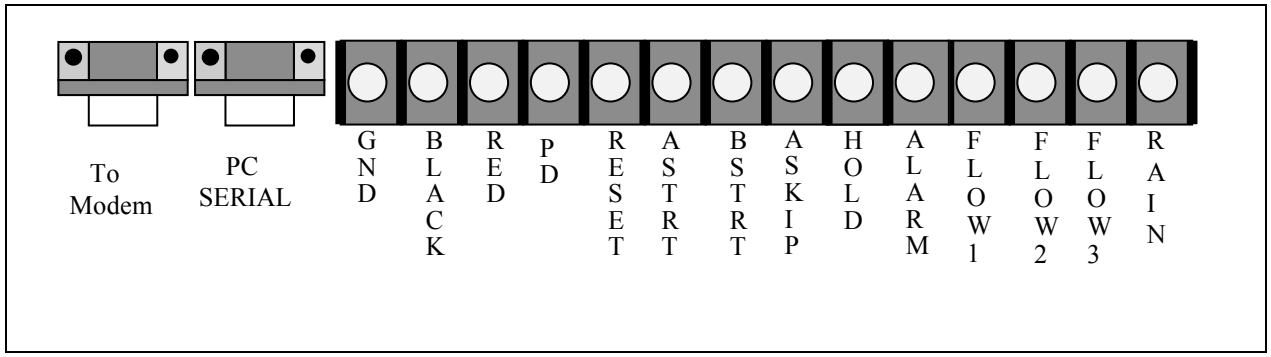
7.2 Pause Irrigation from the keyboard

If it is necessary to interrupt the Irrigation program, Press the ←.The screen will now display.
e.g. pause irrigation during Program 5 at Station 1 with 5 minutes remaining

```
PROGRAM  5 STN 1 = 0005m
KEYBRD HOLD ←  CONTINUE
```

The Irrigation and the Pump will now be switched off.
To continue Irrigation Press the ← key again. Irrigation will now continue from the point where it was interrupted.

7.3 External Connections and Functions



All MicroMaster® inputs react to the closing of a normally open switch or circuit. Many devices are available which close or open a switch in response to some external stimulus and can be connected directly to the controller.

7.3.1 GND.

Common Terminal for Inputs, i.e. ASTRT input sensors connected between ASTRT and GND. etc

7.3.2 **BLACK** RS485 terminal Black.

Used for RS485 2 wire communications. Transmission is differential between the RED and Black wires. Black and red wires cannot be reversed. No damage to the controller will result , but communications will fail.

7.3.2 **RED** RS485 terminal Red.

Used for RS485 2 wire communications. Transmission is differential between the RED and Black wires. Black and red wires cannot be reversed. No damage to the controller will result , but communications will fail.

7.3.3 P.D to GND

Pressure Differential switch input. When a contact between PD and GND is closed,
the filter program will be activated, if a valid filter program has been entered and Irrigation is in progress.

7.3.4 RESET To GND

When this circuit is closed the controller will terminate current program operation, return to the home screen and wait until the next program to start. This function operates on all programs and could be used in conjunction with a normally open moisture switch, such as a tensiometer or more commonly a rain switch. An irrigation cycle **will not be attempted** while the contacts are closed across the RESET Input and GND.

7.3.5 ASTRT To GND (External Program 1 start)

When normally open contacts close across ASTRT - GND, the controller will start Program 1.

NOTE: An entry greater than 0 must be entered in the Cycles/Day Table for the current day.

ASTRT can be used for *Slaving* two controllers together (*See Controller Slaving*)
or more commonly used to start an irrigation program with an external Sensor.
e.g. a moisture sensor or equivalent to indicate that the soil is dried out.

For example,
Place the sensor in the influence of the valve on Station 1.
Set the run time of each station to 5 minutes.
Set the number of cycles of irrigation to 1.
The following will occur :- When the contacts close, Program 1 will start and irrigate all programmed stations. If the moisture sensor contacts are still closed, program 1 will irrigate again. This will be repeated until the moisture sensor contacts open. The controller would then wait for the moisture sensor switch to close again to initiate the next irrigation.

7.3.6 BSTRT To GND (External Program 2 start)

When the circuit B-STRT TO GND is closed, the controller will switch on program 2.

NOTE: An entry greater than 0 must be entered in the Day Table for the current day.

BSTRT can be used for *Slaving* two controllers together (*See Controller Slaving*)
This input is most commonly used to activate an emergency program to counteract potentially damaging factors such as frost or extreme heat, dust or sand. It may of course be used as a second primary irrigation cycle. In the Emergency Program 2 configuration, Program 2 would be set to cycle rapidly through its watering sequence (i.e. short station Run times). A normally open temperature switch would be connected between the BSTRT and GND terminals. Program 2 would then repeat until the temperature switch opened and then operate to the end of program 2 and finish.

7.3.7 A.SKIP To GND (Auto-Skip Input)

A.SKIP stands for Automatic Station Skip. When this circuit is closed, the controller will scan the A.SKIP for a pre-selected interval, terminate the current station, skip to the next programmed station, and close a relay contact (Alarm output). The faulty station will be stored in the Fault Table for viewing at the end of irrigation. If a Central is connected, this will be reported and stored on disk.

The most common device used to activate this function is a pressure switch. This switch is set to remain open while pressures remain within a pre-set acceptable range. If the pressure in the line being sensed exceeds or falls below the pre-set range, the A-SKIP function will be activated. (e.g. if a pipe bursts or a valve fails to operate the pressure switch will be activated.) To avoid unnecessary "skips", two Auto-Skip times can be programmed into the controller. These delay

times allow sufficient stabilization to occur after system start-up or hold before the A.SKIP function begins sensing input status.

7.3.8 Hold To Gnd

The hold input circuit, when closed, instructs the controller to temporarily suspend all operations (except time of day) and resume at the same point in the program when the hold input is released. (i.e. when the Hold input circuit opens.) While a controller "Hold" is in action The screen will display

```
IRRIG PAUSED - HOLD INPUT
END KEY TO CANCEL IRRIG
```

A common application of the Hold input is a normally open level switch, sensing the storage level in a tank or dam. If outflow and inflow are in periodic imbalance, the intermittent nature of the supply can be overcome as the Hold input will suspend the irrigation when the level switch senses a low water level. The irrigation will be put on HOLD and irrigation will not be permitted until the sensed level is sufficiently high to allow further pumping. A power failure will result in the same controller reaction to the HOLD Input except the screen will display

```
IRRIG PAUSED - POWER FAIL
END KEY TO CANCEL IRRIG
```

All irrigation is suspended until the power is re-instated. The program will continue from where it was when the power failure occurred (provided a back-up battery is installed).

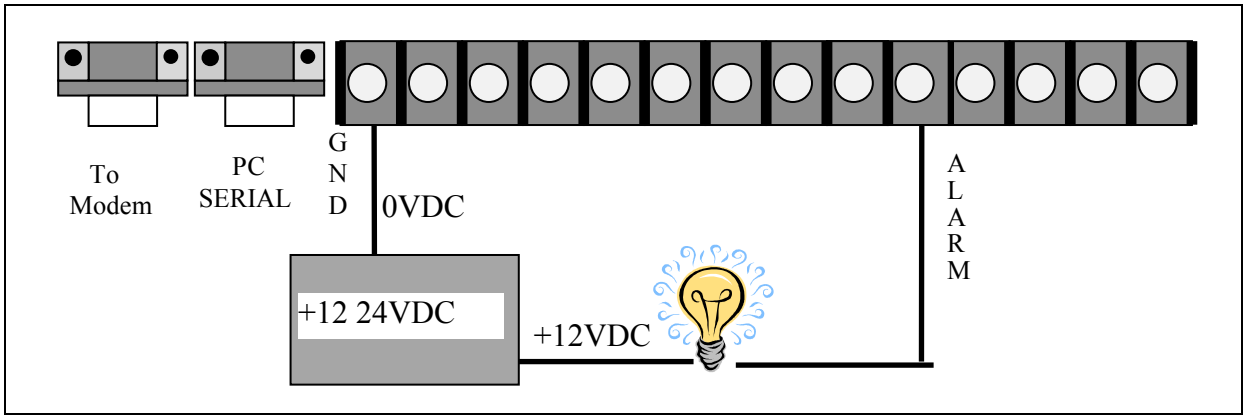
7.3.9 Alarm Output

When the Auto-Skip function is actuated due to a fault or sensed conditions, the alarm output terminal is switched to GND. In order to actuate an alarm device, an external power source not exceeding 30 VAC or (30 VDC) at 1.5 Amp Max must be used. This is done to reduce the current draw requirement of the controller so that more power is available for valve actuation. *For alternative configurations see 7.7.2.*

The Normally open contact of the Alarm output is also compatible with most auto-dialers e.g. ParaVox or equivalent. It has 4 inputs to report the status of other functions such as Chemical level, pump failure etc.. It can be programmed over the phone and the messages sent to a phone or pager.

7.3.10 FLOW1 to GND (Irrigation Flow meter)

This is the input for the pulse flow sensor for ***irrigation***. Select the number of pulses to operate



between 1 pulse every 8 to 120 seconds. It should be noted that the longer the period between 2 flow meter pulses, the longer it takes to calculate the flow-rate.

7.3.11 FLOW2 to GND (Chemical 1 injection flow meter.)

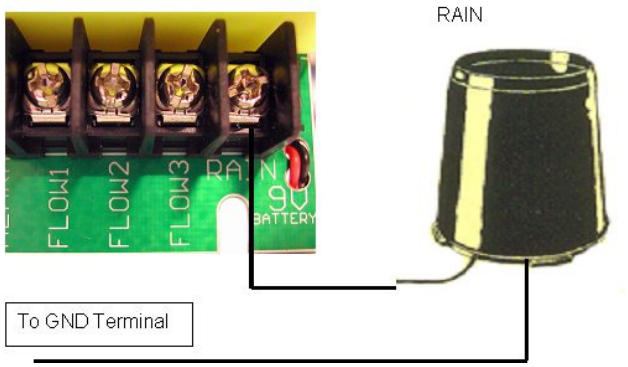
This is the input for the pulse flow sensor for ***Chemical 1 Injection***. Select the Number of pulses between 1 pulse every 4 to 120 seconds. It should be noted that the longer the period between the flow meter pulses, the longer it takes to calculate the flow-rate.

7.3.12 FLOW3 to GND (Chemical 2 injection flow meter.)

This is the input for the pulse flow sensor for ***Chemical 2 Injection***. Select the Number of pulses between 1 pulse every 4 to 120 seconds. It should be noted that the longer the period between the flow meter pulses, the longer it takes to calculate the flow-rate.

7.3.13 RAIN to GND (Rain Bucket for rain cancel function.)

This is the input for the Rain bucket sensor used for the rainfall cancel function. Select the Number of pulses /mm (Micro-Master rain bucket = 5 pulses /mm. At the controller press Sensors and enter the rain bucket calibration.



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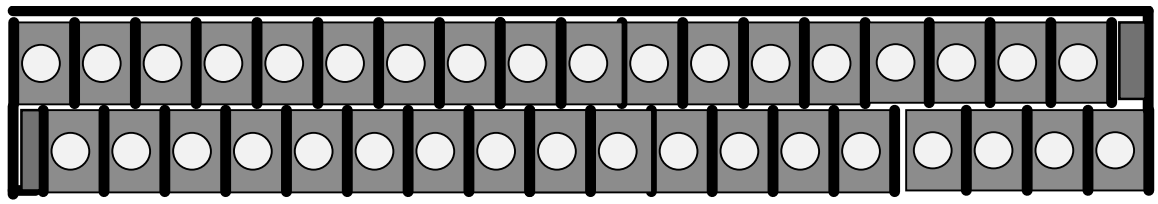
7.4 Output Connections

The output connector is a 36 way connector that can be unplugged when servicing, so that field wiring does not have to be disconnected.

COM. Two terminals.



Connect to the common of all field valves and Pump Start wires.

Terminals 1 - 25. Connect to each of the field valves.

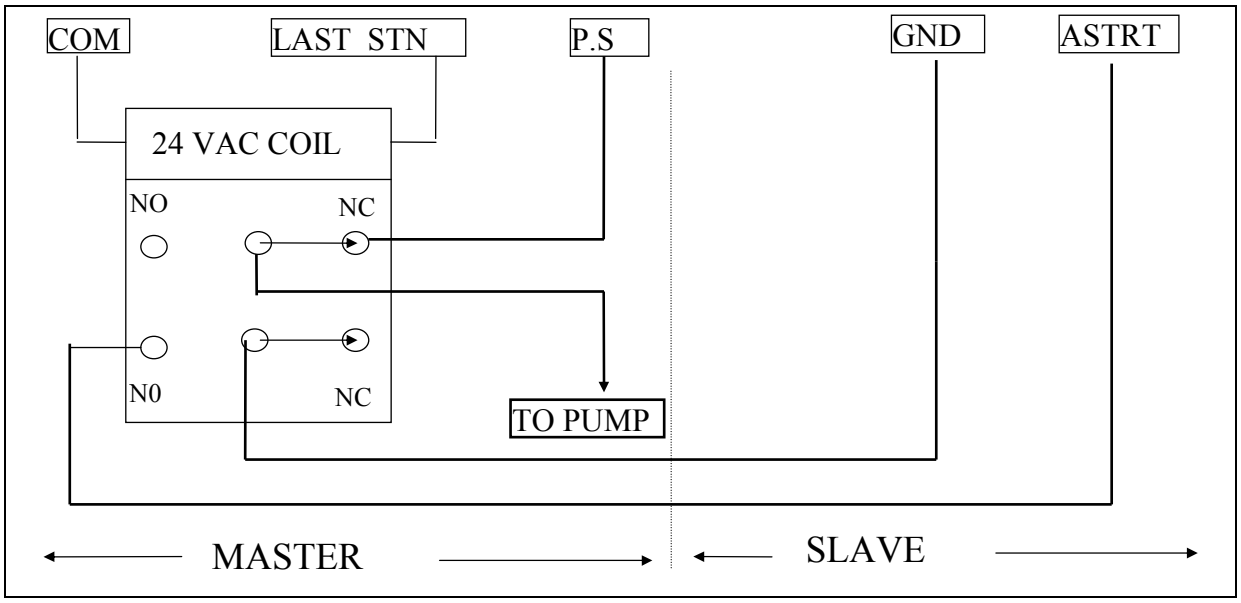
Terminals 26 - 29. Connect to filter stations 1 to Filter station 4.
(note: if operating in Group mode and filters are not being used, stations 26 - 29 can be used for irrigation).

Terminal 30 - First Injection Pump Output. Connect to First injection pump.
Terminal 31 - Second injection Pump output. Connect to Second injection pump.
Terminal 32 - Premix output. Connect to mixing pump for premixing of Chemicals

(note: if operating in Group mode and Chemical injection is not being used, stations 30 - 32 can be used for irrigation).

Terminal Pump Start.
Connect to the Pump Start Relay or Master valve. When irrigating, this terminal will be active.

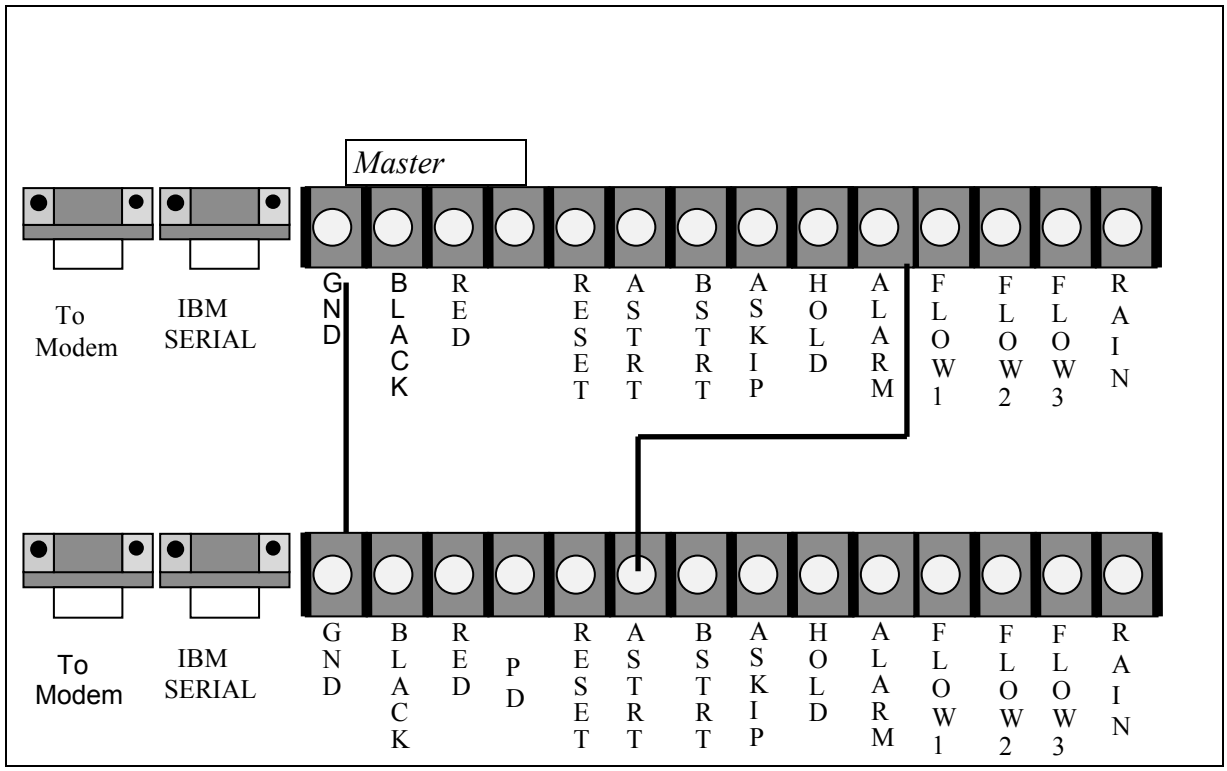
Earth Stake (12 Volt DC Operation only)
Do not connect Earth Stake when 240VAC operation. This point is directly connected to the field surge protection circuits. When large field surges (i.e. lightning) are induced into the field wiring, a low resistance path to earth is essential. Connect this terminal to the earth Stake using 4mm - 6mm stranded wire.
(See hardware installation instructions).



7.5 Master Slave Operation using a spare station

For this operation a spare station is required. *e.g. station 25.*
Program this station for 1 minute (2 seconds minimum.) in a group or in sequential mode.
Operation.
An Omron LY2 or equivalent relay (coil 24 Vac at 50 ma and 2 DPDT contacts) is ideal for this purpose as the contacts can switch 240 volt AC with a very low coil current . Most of the transformer current is then available for the field valves.
The pump start output is connected through the first set of normally closed contacts.
When station 25 operates, the pump will be switched OFF.
The second set of contacts will close, and activate the ASTRT input of the slave controller.
Note: The ***Day Table*** must be set on the Slave for Program 1 to operate.
Program 2 operation can be activated in the same way.

7.5.1 Master/Slave operation using ALARM terminal.



The 4500Plus can be setup to Master Slave Program 1 in the following way.
Press Setup until **ALARM O/P 2** is displayed. Press key 2 to select the alarm setup function.

```
INVERTER KEY 1   ALARM 2
MASTER/SLAVE 3     END=EXIT
```

The following screen is displayed.
When key 3 is pressed, the alarm output will be setup as the **Master** slave trigger. It is a normally open contact that will close 2 seconds before the completion of
Program 1. The **ALARM** output of the Master can now be directly connected to the **ASTRT** or **BSTRT** of the slave controller as in the diagram above.
Note: The **Day Table** and Runtimes on the slave controller must be programmed (no Start Time is necessary) for the Slave to operate. The **Day table** entry allows the Slave program to operate only on those days required by the user.

7.5.2 Screen Indication of Master Operation.

```
4500M25  003  MON W1  12:35
 CHEM PRG 5 TUE W1    06:35
```

To indicate that a controller is the master the + in 4500+25 is changed to 4500M25 to indicate that it is the Master.

Each controller will operate as per the programming and Setup installations of each individual controller. e.g. The master (the controller with the programmed *Start Time*) can be Volumetric grouping and the slave can be Time base sequential operation.

7.6 Inverter Control / Solar Operation

The Solar power option for a Micro-Master 4500Plus generates 24 VAC to operate standard 24 VAC solenoid valves. The Benefits of this are as follows.

1. Wiring for 12 volt DC valves require expensive double insulated wire to prevent electrolysis break down of cable.
2. 24 VAC valves require half the wiring diameter than that used by 12 VDC valves. Calculate wire size as for standard solenoid valves.
3. Latching solenoid valves must be installed close to the controller because they require a very large initial current to latch (approx. 2 amps). The wire must also be double insulated for the same reasons as (1) above.
4. Latching solenoid valves are expensive.
5. Hydraulic valves cannot be used in undulating terrain.

The Solar power option consists of

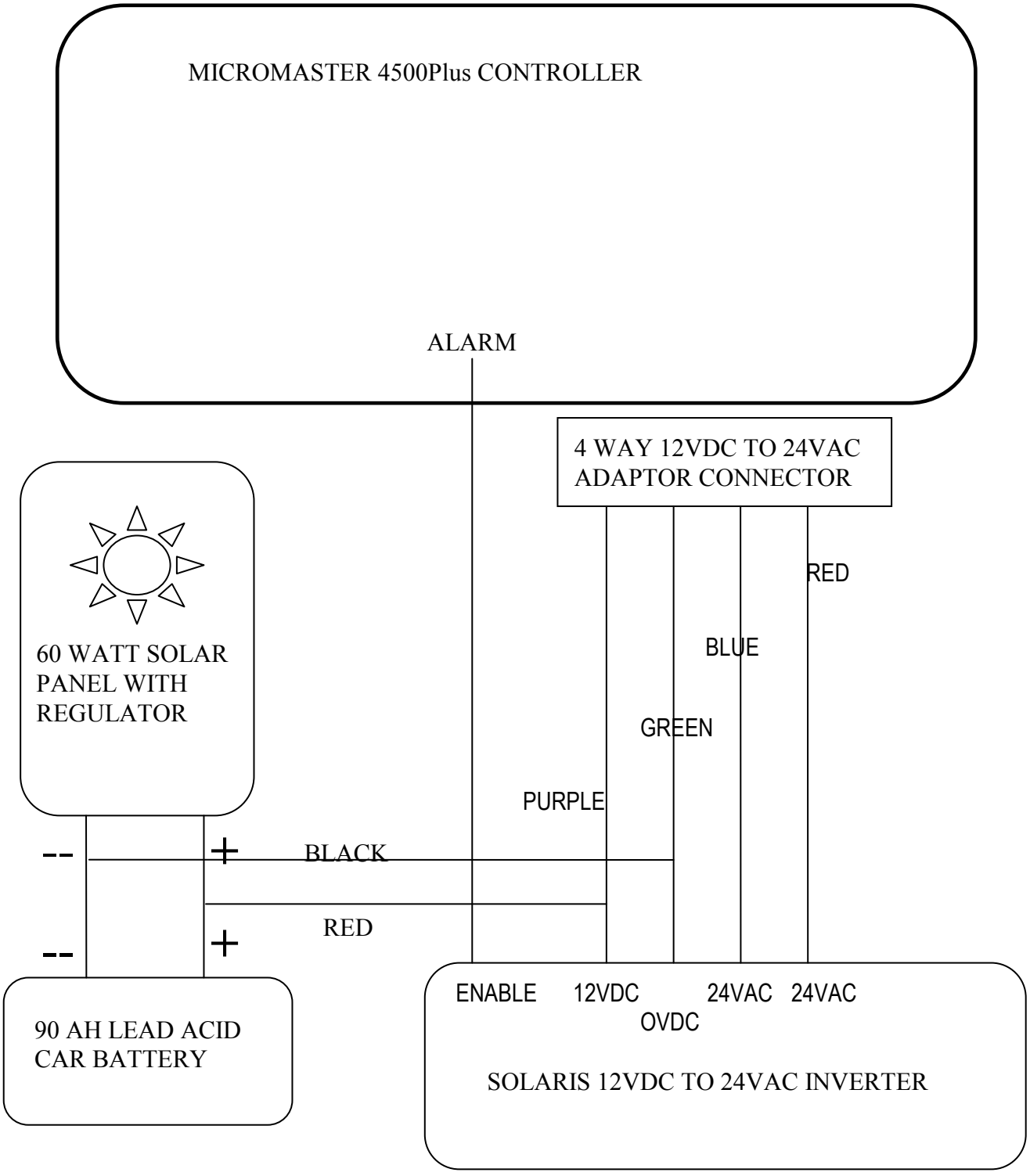
- 60 Watt Solar Panel.
- MSX1 frame for roof or wall mount.
- 12 Volt DC to 24 Volt 2.5 Amp AC Converter. (IP66 weatherproof enclosure).
- SR4 Solar Regulator.
- 6 metres twin sheath cable 3.2mm^2
- Micro-Master Solar adapter cable.

NOTE: Battery to be supplied by the user.
Recommend standard 12 volt 90 Amp hour motor vehicle battery.

For the sake of simplicity, the following table gives an indication for Winter and Summer operation. Following is the number of valve hours that the system can operate in a continuous 24-hour day.
E.g.
40 valve hours = 4 valves operating for 10 hours OR
2 valves operating for 20 hours.

Location	Winter Valve Hours	Summer Valve Hours
South of Melbourne and Tasmania	17.5 Valve Hours	42 Valve Hours
Rest of Australia	22.5 Valve Hours	45 Valve Hours

To prevent the inverter using current when not in use, the Alarm output of the controller has been utilized to switch on the inverter only when irrigation is required. For this purpose the controller loses it alarm output capability.
See Wiring Diagram on page 47.



Wiring Diagram for connecting Micro-Master 4000 and 4500Plus to a Solaris 12VDC to 24VAC inverter. Disconnect the 4 way connector between the mains transformer and the relay board. Connect the 4 way connector of the 12VDC to 24VAC adaptor connector to the 4 way connector of the relay board. Connect the wire labeled Enable to the alarm output. Connect the Red wire to the + terminal of the battery. Connect the Black wire to the - terminal of the battery Connect solar panel as above ie + to + and – to -. Program
Output see page 48. Setup is now complete.

To convert the controller from 240 volt to solar power operation, the following setup is required.

1. Remove the front panel of the controller.
2. Disconnect the 4 way power cable to the controller relay board.
3. Connect the 4 way solar connector to the power cable connector of the relay board.
4. Connect a wire between the EARTH STAKE terminal (last terminal on the right of the valve output connector see diagram on page 39 and the GND terminal on the top processor board last terminal on the right see diagram on page 36.

7,6.1 Program Setup

Press **SETUP** until **ALARM O/P 2** is displayed. **Press 2**

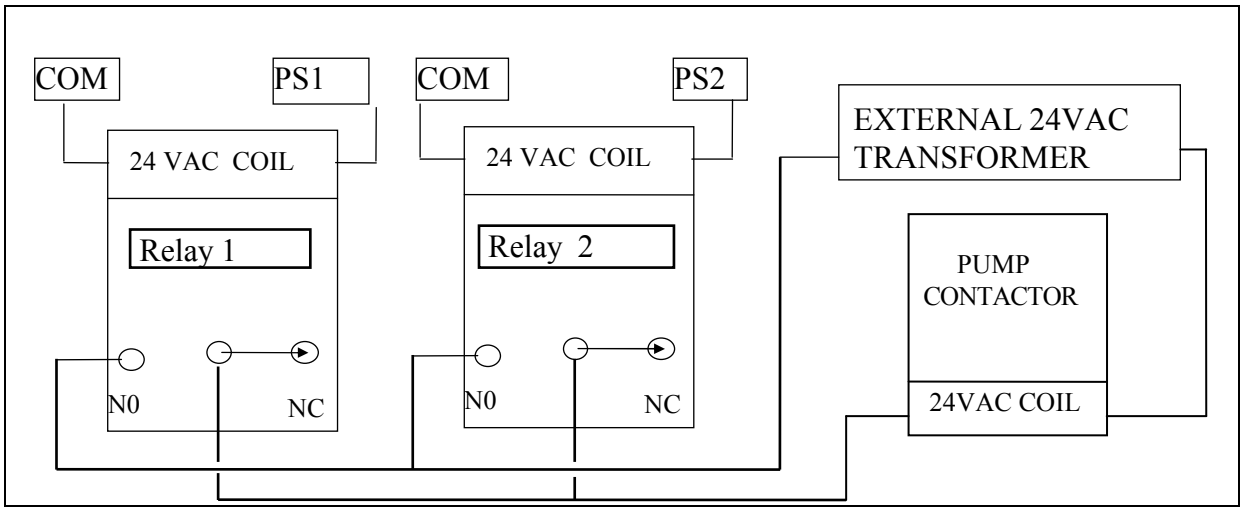
```
INVERTER KEY< 1 ALARM KEY 2
MASTER/SLAVE 3     END=EXIT
```

Press **1** key to enable the Alarm Output to control the 24vAC inverter.The controller will now display a arrow to INVERTER to indicate that this option has been selected.

Note: To Setup Alarm output for standard Alarm ,Press Key 2. The alarm output will now operate as the default setup for the Alarm. In this case the arrow would point to ALARM

7.7 Connecting 2 or more Pump Starts Together

Outputs from different controllers cannot be connected together because of the phasing between the transformers. The above method can be implemented using a common transformer (ie Irritrol Systems 24 VAC plug pack.). When any pump start operates, one or the other or both of the relays will operate activating the pump relay.



Appendix 1 Installation Instructions

1.1 Hardware Installation

The Micro-Master® 4500Plus Series Controllers can be mounted in one of 2 ways
1. Wall Mount
2. Mounted on 50 mm PVC pipe with standard fittings.

1.1.1 Wall Mount.

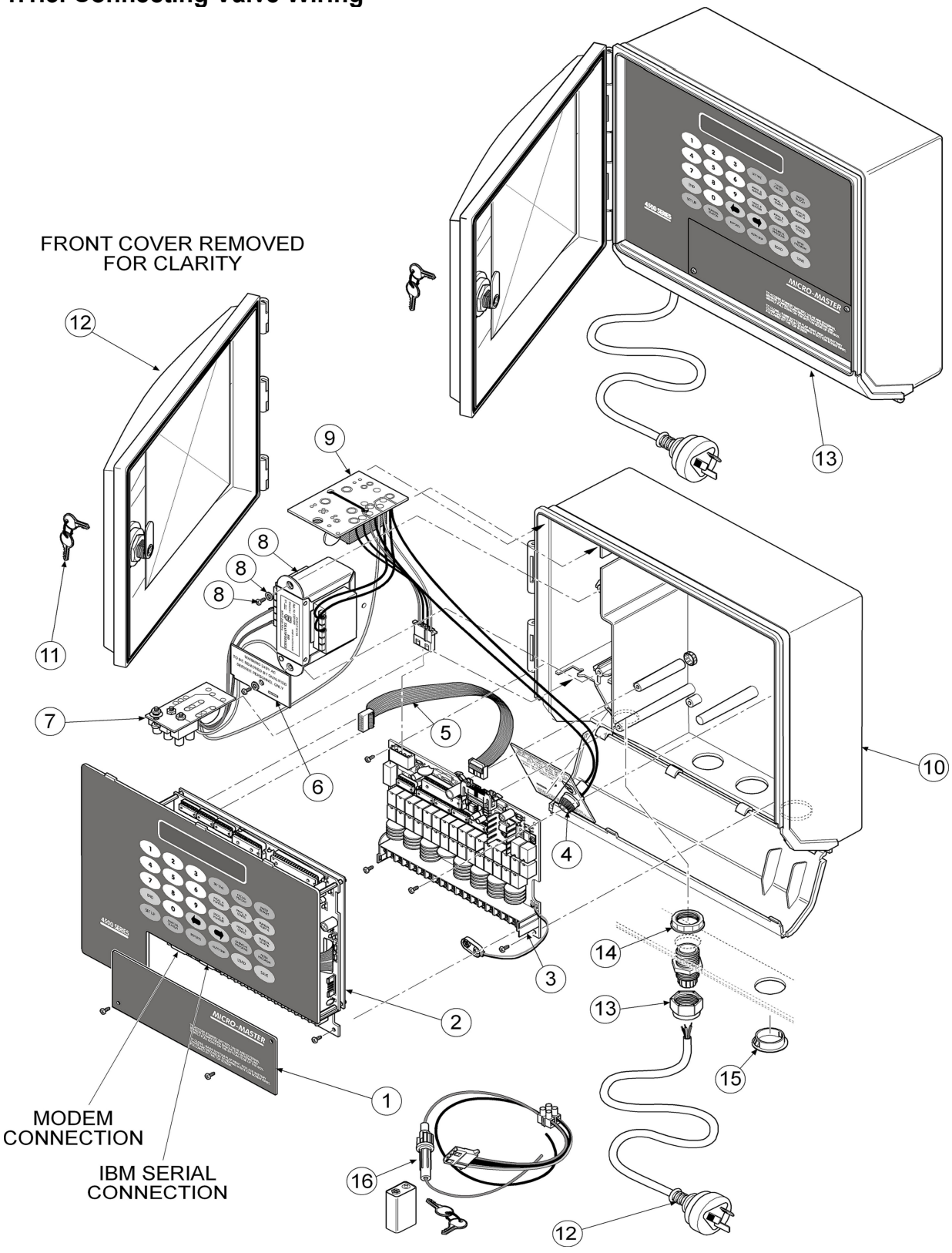
On the back of the controller is a "keyhole" shaped mounting slot as well as 3 mounting holes along the bottom edge. Access to the 3 mounting holes is from the front behind the bottom cover plate.

NOTE: The holes have thin knock out partitions to protect the controller internals from the elements should the holes not be utilized. This partition is easily knocked through using a "Philips head" screwdriver.

When attaching to wall studs use a No. 10 self tapping screw and leave approx. 6mm of the head exposed to slip into the "keyhole" slot. To secure and stabilize the controller, drive additional screws through the bottom mounting holes.

NOTE: When mounting the controller to a sheet metal wall, it is essential to mount timber mounts to the wall first and then mount the controller to the timber. This prevents high temperatures being conducted to the controller.

1.1.3. Connecting Valve Wiring



1. Open cabinet door.
2. Remove bottom right hand panel(labeled as 1) by unscrewing the two Phillips head screws.
3. Lower the bottom flap-door (13) of the controller.

4. Remove one (or more if necessary) of the hole plugs in the base of the cabinet.
5. Route the cables for each valve through the hole in bottom of the controller cabinet. Insert each lead under the appropriate screw on the terminal block. If there are multiple common wires, they should be connected into one common wire and attach to either of the terminals marked "COM".

Note: Use a cable sealing gland similar to the one used for the 240VAC power lead, to help seal the field wiring entry hole in the cabinet.

6. When complete, push bottom flap back into place and restore the bottom right hand panel. Always keep the cabinet door closed.

1.1.4. Earth Stake (12 Volt DC Operation only) Do not connect Earth when 240VAC

The Micro-Master® 4500Plus Series controllers have a high level of field surge protection. (6500 amp 20usec). For this to work, effectively, a good low resistance earth path must be provided to shunt the surges. In severe lightning areas a *2 metre earth stake* connected to the *E (Earth Stake)* terminal on the far right of the terminal block can be used.. (*Use multi-strand 4-6mm wire.*) Ensure soil around the earth stake is kept moist to create a good earth.

1.1.5. Standby Battery

The Standby Battery is a 9v alkaline MN1604 miniature Battery*. This will give approx. 100 hours of standby time*. The alkaline battery is essential in high temperature conditions as they have a shelf life of approx. 5 years at 40 degrees Celsius. In the long term, an alkaline battery will be more reliable and cheaper than an equivalent NiCad battery. They are replaced every 1 to 2 years depending on the number of power failures in the area.
Note: For extreme conditions with many power failures, a battery holder with
(6 AA alkaline cells) will give a Standby time of approx. 500 hours.

NI-CAD (Nickel Cadmium) batteries ***should not be used for 2 reasons***.
1. For a Ni-cad to be efficient, the operating cycle should be fully charged, then fully discharged. This is not the case for a Standby battery in an irrigation controller.
2. Poor operation in a high temperature environment. The capacity is only 20% of an alkaline cell and this is further reduced in high temperature environment.

The 216 standard carbon zinc battery should not be used because of very poor high temperature performance and low capacity.

1.1.6. 12 Volt DC Operation

The 4500Plus series controllers can be easily changed to operate on 12 VDC .It should only be used with caution as valves must be fitted locally as wires carrying DC current should not be installed under ground because of electrolysis. Ideal installation when hydraulic valves are used.
1. Remove the 4 way connector from the transformer.
2. Plug in the 12 VDC adaptor plug .(labeled 9 in the above exploded Diagram.)
3. Connect the RED lead to + 12 VDC.
4. Connect the BLACK lead 0 VDC.
5. Connect Earth stake per point 4 above.

Appendix 2 Technical Specifications

Main Input Power

240 volt 50 Hz single phase - Standard
(110 volt - 60 Hz available on special order)
12 volt DC (11 volt minimum - 17 volt maximum
Quiescent 12 volt input power 15 mA at 12 VDC
(45 mA with one output relay and pump start relay activated)

Output Power

Station Capacity :	24 volt AC at 2.0 Amp max. 8 (2 watt valves).
	12 volt DC at 2.0 Amp max.
Pump Start Capacity	24 volt AC at 1.0 Amp max.
	12 volt DC at 1.0 Amp max.
Total Controller Capacity	24 volt AC at 2.0 Amp max.
	12 volt DC at 2.0 Amp max.

Inputs

Function	Reset, Hold, Auto Skip, Program A Start , Program B Start , P.D (Pressure differential Filter control) Flow 1 input, Flow 2 input, Flow 3 input, and Rain bucket input
Input Impedance	6800 ohm
Operation	Normally Open contacts: Maximum loop resistance 300 ohm.

Alarm

Normally open contacts closing to ground for fault alarm.
Alarm requires external power source (see ALARM output).
Maximum voltage for external Alarm 30 VDC / 30 VAC.
Maximum current for external Alarm 0.5 Amps.

Power Cable

AC Models supplied with " 2-core-and-E " circular cable and a 7.5 Amp three-pin flat-pin plug complying with Fig. 1a of Australian Standard AS 3112.
DC Models supplied with 4 way bypass plug to supply external DC power.

Display

Two row by 24 character Back-lit Liquid Crystal display. 5.5 mm high.

Lightning/Surge Protection

Mains	Surge protection 2500 Amps surge for 20 microseconds.
Valve Outputs	Field surge protection 6500 Amps for 20 microseconds.
inputs -	Surge Protection 250 Amps surge 20 microseconds.
	50 Hz induced Voltage 10 V RMS. Max.

Ambient Operating Conditions

Temperature	-10~C to 60 °C.
Humidity	Maximum 95 % non-condensing.

Hardware

Processor	Dual Low Power CMOS Integrated circuit technology.
Processor protection	Varistor 1000 amp 20 usec, and secondary Transorb 1.5KE.

Relays

Sealed, high-current (3 Amp)	Gold Plated Silver alloy contacts.

Fuse

Type	24 volt AC. 3 Amp (in-line housing).
Size	20 x 5mm - 3 AG.
Internal over load Protection	triggers at approx. 2.5 Amp and Auto Skip.

Standby Battery

Type	Miniature 9 Volt alkaline MN1604B.
Life	100 hours standby (nominal).

Cabinet

Lockable, weather proof.

Dimensions

300 x 220 x 130mm.

Mass

3.0 kg.

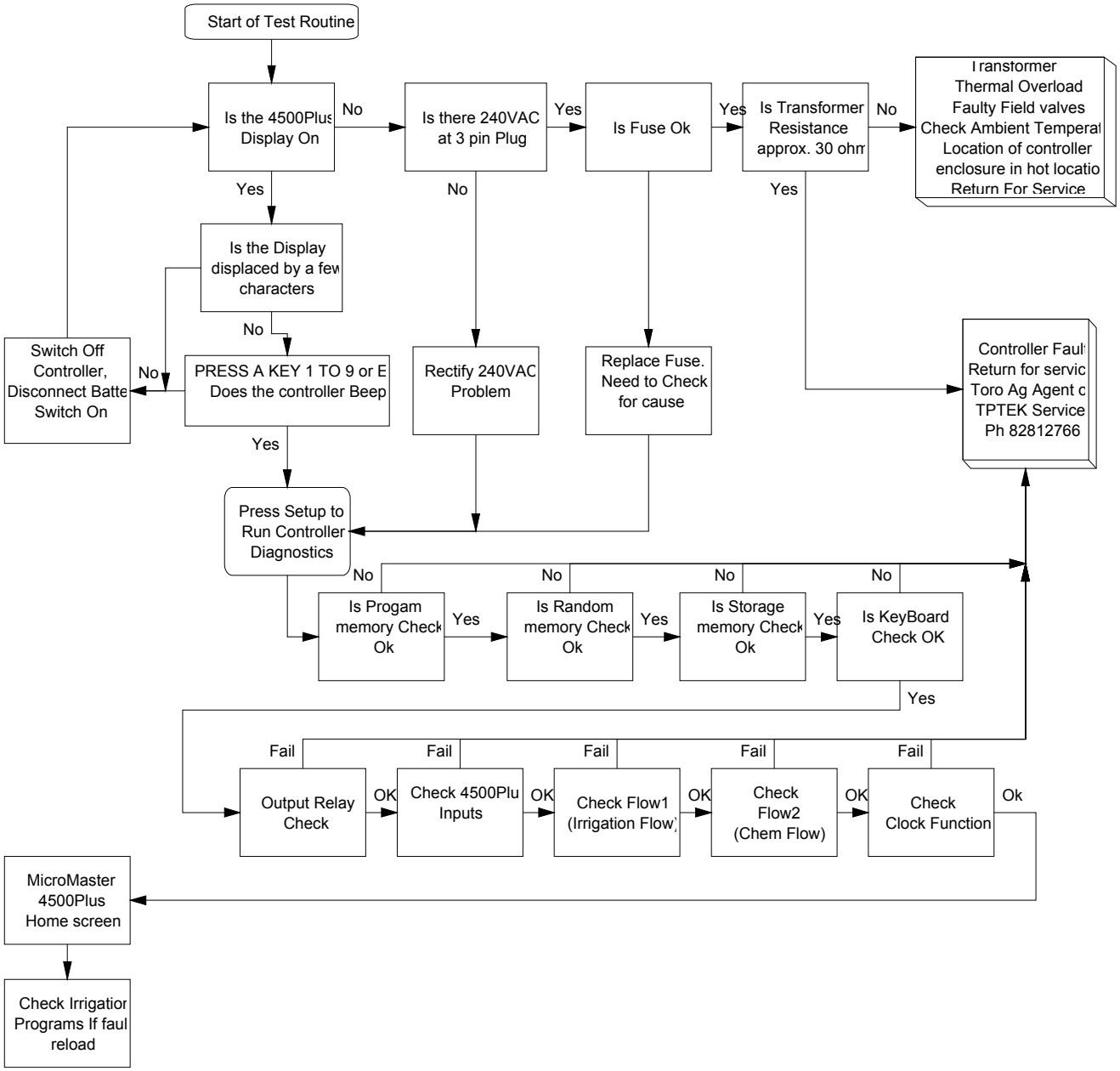
Main Components

Mains Transformer	TFD 62570.
Isolation Transformer	TF75461 24VAC primary - 12VAC secondary at 400mA.
Input / Output Connectors	Maximum conductor size 2 X 6mm per terminal.
Key-Pad/Front Panel	6 x 5 (30) key totally sealed, polycarbonate, scratch. resistant with built in electrostatic shield.
Logic Board (Front)	mounted on rear of front key-pad panel.
Output Board (Rear)	mounted to base of cabinet. with output connectors. Logic and output boards interconnect by 14-way flat ribbon polarised connector.

*Reference to specific products, services or companies in this publication does not imply endorsement or specific recommendation of any product, service or company.

Appendix 3 Fault Finding

MicroMaster 4500Plus Fault Finding



1.1 Fault Finding – Possible causes

Problem	Possible Cause	Correction
Wrong Time of Day	A power failure has occurred and the Battery was flat	Set the time replace Battery if required

Will Not Start an Irrigation Program	Check cycles/Day Table Check Rain Switch Check the Start Time Check Water Budget	Refer programming sheet and program.
Irrigation Time is Shorter Than Programmed	Check Water Budget Auto Skip Fault has occurred Check Runtimes	Re program Check fault table Re program
Irrigation Time is Longer Than Programmed	Power failure has occurred during irrigation. Check Run Times Check Water Budget A HOLD occurred during irrigation	
Display Indicates Irrigation in Progress but Pump and Valves are not switched ON	Faulty Fuse Faulty wiring or valves	Replace fuse Check wiring & valves.

Display does not start at the edge of the screen.
Remedy. Switch off the controller and remove the standby battery. Wait 5 seconds and switch on again. The Controller has 2 microprocessors and need to be synchronized when switching on

1.2. Checking field wiring and valve currents

The fuse is only common to the field wiring, and if it "blows", it is not caused by the controller logic. To investigate the cause of the fuse "blowing" open the fuse holder and connect in series an AC current meter with a current range of at least 10 Amps.

With the meter in place, press **MANUAL VALVE** Note the current and enter the values into the commissioning sheet below together with the wire color. (if a radio control valve then enter the RadioMaster address) . Press → to advance through the stations until the suspect station(s)

are found .Then check the wiring and valves to that station. Valve boxes full of water can create high current shorts across valve wiring joints during irrigation.

1.3 Fill in Commissioning Table

MicroMaster 4500Plus Controller Valve Output Commissioning Sheet				
			Radio-Master Idcode	
Station Number	Valve Location	Valve Current	Or wire colour	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
PUMP START				

Suspect Valve outputs

Whenever a valve output is suspected of a malfunction, carry out the **Checking field wiring and valve currents** and compare with the valve current readings taken during the initial commissioning. If more than 1 valve comes on at a time, disconnect the wires from the outputs and check the voltage at these outputs. The voltage must be over 24VAC to be a valid voltage. e.g. if the voltage on an output terminal measured 7 - 16VAC, with a valve connected, then the result of this test would indicate that there was an open circuit in the valve solenoid or a broken wire.

For the pump start wiring, a good practice is to operate a small relay (OMRON LY2 or equivalent) which has a 24 VAC at 50 mA coil and 240 VAC at 5 Amp contacts. These contacts can switch a contactor with a 240 VAC coil of almost any size.

1.4 Voltage readings on unused Valve outputs

The 24VAC is a floating output. I.e. it does not have any reference to Gnd. The following readings are normal.
When no valves are operating, the voltage between **Com** to **unused stations** is approx. 7VAC
When one or more valves are operating, voltage between **Com** to unused stations is approx. 16VAC.
This is due to the feedback through the surge protection devices.
The surge protection devices have a very high impedance to normal voltages. Therefore no current can be sourced from these outputs under these conditions.
When a standard solenoid is connected across these inputs the voltage will be 0VAC.
The varistor surge protection devices will change to a very low impedance only under over-voltage surge conditions in excess of 50VAC.

1.5 Sensor Information and Calibration

MicroMaster Sensor Inputs	Calibration or Sensor Function	Comments
Irrigation Flow (Flow 1 input)		
Chemical Flow (Flow 2 input)		
Chemical Flow (Flow 3 input)		
Rain Bucket Input (RAIN input)		
External program A Start		
External program B Start		
Hold Input		
Auto-Skip Input		
Reset Input		
Filter PD Input		
Alarm Output		
Communications		
RadioMaster		
RS232		
RS232 VHF Radio		
RS485		
RS485 Radio-Master		
Telephone Modem		
GSM Modem		

Appendix 4 Glossary Or Terms

AUTO-SKIP A method of sensing a faulty station, switching it off, and skip to the next station.

CYCLE A programmed irrigation from stations 1-16 or 1 to 32. Can be repeated using cycle repeats.

CYCLE REPEAT Allows for cyclic watering. i.e. irrigate, allow time to infiltrate, and then apply more irrigation. 1 = 1 cycle of irrigation.
2= 2 cycles of irrigation etc.

CYCLE DELAY If a cycle repeat value is greater than 1, a delay can be inserted between the cycles to allow water to infiltrate into the soil.
Some times called “Cycle and Soak”.

DAY OF WEEK The day of the week in a 14 day schedule.

DEFAULT The Factory set program values within the controller when the controller is purchased.
Can be reset to DEFAULT values using SETUP key and selecting CLEAR PROGRAMS.

DIAGNOSTICS A method of testing controller functions if a fault is suspected.

GROUP A selection of valves “grouped” together to operate with a common Runtime

HOLD An input to the controller. When a contact closes across this input the irrigation will be “Paused” or “Suspended “ until the contacts open gain.

HOME SCREEN Controller display in normal time of day outside of irrigation cycle or manual operation.

MANUAL Allows a single station to be started at any time.

NON SEQUENTIAL Field valves can be switched on randomly in any order.

PAUSE During a power fail or HOLD input irrigation will be paused until the power fail or hold is removed.

PROGRAM A combination of entered numbers to determine the time when irrigation will start, the time watering will occur for, and the days on which this irrigation will occur.

RAIN SWITCH Allows the operator to switch off all irrigation without modifying any of the irrigation programs.

RUNTIME The time a valve or group of valves is switched on for irrigation to occur.

SEMI-AUTOMATIC Allows a program (i.e. programs 1 to 8) to be started at any time regardless of the programmed start times.

SENSOR INPUT An input to the controller to allow external sensors to have some control on the controller operation.

SENSOR A sensor "senses" external conditions and operates a switch if a pre-defined condition is reached. Typical sensors are Pressure, Flow, Water Level etc.

SEQUENTIAL Field valves will be switched in sequence ,starting from the valve connected to station 1 and increasing to the last station programmed.

START TIME The time of day when irrigation will start.

STATION A controller output or terminal to connect a valve to.

VALVE OUTPUT Same as station.

WATER BUDGET A percentage value that will globally modify the runtime of all station Run times within a program.

NOTES